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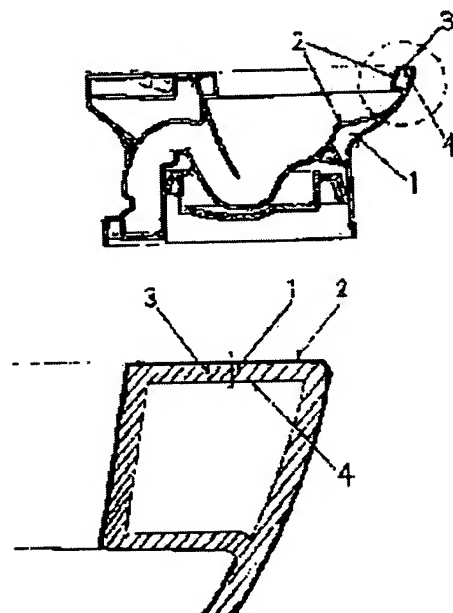
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(54) CERAMIC AND ITS PRODUCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent of the penetration of water with time due to hydration swelling or the problems of damage from coldness injury or contamination by forming the center part of the base of a ceramic from a water absorptive ceramic base and decreasing the water absorption of a part of the surface of the base, where a glazed layer is not formed, than that of the center part.

SOLUTION: The glazed layer 2 is formed on the necessary part of the base 1 of the ceramic, the center part 3 of the base 1 is formed from the ceramic base having water absorptivity and the surface part 4 is formed from the ceramic base having smaller water absorptivity than that of the center part 3. That is, the composition of the center part 3 is controlled to 45-70 wt.% SiO₂, 25-50 wt.% Al₂O₃, ≤2 wt.% total of an alkali metal oxide and ≤6 wt.% total of an alkali metal oxide and an alkaline earth metal oxide. The composition of the surface part 4 is controlled to 45-70 wt.% SiO₂, 25-50



wt.% Al₂O₃, ≥ 5 wt.% total of the alkali metal oxide and ≥ 6 wt.% total of the alkali metal oxide and the alkaline earth metal oxide.

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CLAIMS

[Claim(s)]

[Claim 1] It is the pottery characterized by being the pottery which consists of a cover coat layer formed in a base and the required portion on it, for the center section of the aforementioned base consisting of an earthenware simple ground with absorptivity, and absorptivity being smaller than the center section of the aforementioned base in the portion in which the cover coat layer is not formed at least among the surface sections of the aforementioned base.

[Claim 2] It is the pottery characterized by an ink penetrance being 3mm or less in the portion in which it is the pottery which consists of a cover coat layer formed in a base and the required portion on it, and the center section of the aforementioned base has an ink penetrance larger than 3mm, and the cover coat layer is not formed at least among the surface sections of the aforementioned base.

[Claim 3] The composition of the principal component of the center section of the aforementioned base is 245 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 2 or less % of the weight. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, The total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO is 6 or less % of the weight. the surface section of the aforementioned base Composition of the principal component is 2:45 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 5 % of the weight or more. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, Pottery according to claim 1 or 2 characterized by there being more total amounts of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO than 6 % of the weight.

[Claim 4] Pottery according to claim 3 further characterized by at least one sort of minerals chosen from the group which consists of a quartz, a cristobalite, a mullite, and corundum containing as a crystal at the center section of the aforementioned base.

[Claim 5] Pottery according to claim 3 or 4 characterized by there being more weight % of Na₂O than weight % of K₂O in the content of an alkali-metal oxide among the components which constitute the center section of the aforementioned base.

[Claim 6] Pottery according to claim 3 to 5 characterized by a Na₂O content being 1 % of the weight or more among the components which constitute the center section of the aforementioned base.

[Claim 7] A phi14x130mm test piece is produced using the same base and same cover coat as the

forementioned pottery. The flexural strength computed when a three-point bending test is carried out on condition that span 100mm and crosshead speed 2.5 mm/min by the autograph using the test piece is 30 or more MPas. The same base and same cover coat as the aforementioned pottery are used. And width of face of 25mm, thickness of 5mm, Produce a test piece with a length of 230mm and the test piece is supported by two span 200mm points. Pottery according to claim 3 to 6 which carries out a temperature up to 1000 degrees C in 4 hours, carries out a temperature up to 1200 more degrees C in 2 hours, and is characterized by the amount of deflections of the test piece when cooling naturally to a room temperature being 5mm or less after holding at 1200 degrees C for 1 hour.

[Claim 8] Pottery according to claim 7 characterized by the line coefficient of thermal expansion of the longitudinal direction of the test piece when producing a test piece being less than $[90 \times 10^{-7} / \text{degree C}]$ using the same base and same cover coat as the aforementioned pottery.

[Claim 9] The aforementioned pottery is SANA of a lavatory, a urinal, a closet, a baby bus, and a toilet bowl, a washhand basin, and pottery according to claim 1 to 8 characterized by being either of the toilet bowl tanks.

[Claim 10] The manufacture method of pottery according to claim 1 to 9 characterized by providing the following. The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 . They are alkaline earth metal, such as alkali metal, such as water, and Na, K, Li, and calcium, Mg, Ba, or boron to the aforementioned base raw material.

[Claim 11] The manufacture method of the pottery according to claim 10 characterized by performing processing which speeds up the moisture vapor rate from the aforementioned predetermined surface section in the aforementioned dryness process in order to move many alkali metal or alkaline earth metal by the predetermined surface section.

[Claim 12] It is the manufacture method of the pottery according to claim 11 characterized by for the aforementioned pottery being a closet and the aforementioned predetermined surface section being the interior of a trap or a rim.

[Claim 13] It is the manufacture method of the pottery according to claim 11 characterized by for the aforementioned pottery being a lavatory and the aforementioned predetermined surface section being the interior of overflow.

[Claim 14] The aforementioned processing is the manufacture method of the pottery according to claim 11 to 13 characterized by being the processing which passes warm air or cold blast in order to move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal. [Claim 15] The aforementioned processing is the manufacture method of the pottery according to claim 11 to 13 characterized by being the processing which irradiates the heat by source of the radiant heat like an infrared lamp in order to move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal.

[Claim 16] The aforementioned processing is the manufacture method of the pottery according to claim 11 to 13 characterized by being the processing which adds microwave heating and promotes dryness in order to move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal.

[Claim 17] The compound with the aforementioned dissolved water in fuel is the manufacture method of the pottery according to claim 10 to 16 characterized by being a carbonate, acetate, a sulfate, or a citrate.

[Claim 18] The manufacture method of pottery according to claim 1 to 9 characterized by providing the following. The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 . They are alkaline earth metal, such as alkali metal, such as Na, K, and Li, and calcium, Mg, Ba, or boron to the forming base front face aforementioned after performing the process which forms a forming base by fabricating using the aforementioned base raw material, and the process dried if needed one by one.

[Claim 19] The manufacture method of the pottery according to claim 18 characterized by the method of

application in the aforementioned application process being a spraying method using the ultrasonic wave.

[Claim 20] It is the manufacture method of the pottery according to claim 19 characterized by for the aforementioned pottery being a closet and the aforementioned predetermined surface section being the interior of a trap or a rim.

[Claim 21] It is the manufacture method of the pottery according to claim 19 characterized by for the aforementioned pottery being a lavatory and the aforementioned predetermined surface section being the interior of overflow.

[Claim 22] The aforementioned base raw material as an indispensable component of main minerals A kaolinite, dickite, A halloysite, a sericite, and the argillaceous mineral and quartz that consist of at least one sort chosen from the pyrophyllite are included. At least one sort of minerals chosen from a mullite, corundum, and the diaspor if needed as an arbitrary component are included. The manufacture method of the pottery according to claim 10 to 21 characterized by including alkaline-earth-metal content minerals, such as alkali-metal content minerals, dolomites, etc., such as a feldspar, if needed as other components.

[Claim 23] The aforementioned base raw material is the manufacture method of the pottery according to claim 10 to 22 characterized by the mean particle diameter measured with a laser diffraction formula particle-size-analysis vessel being 1-20 micrometers.

[Claim 24] The manufacture method of the pottery according to claim 10 to 23 characterized by the forming method in the aforementioned forming cycle being slurry casting.

[Claim 25] The burning temperature in the aforementioned baking process is the manufacture method of the pottery according to claim 10 to 24 characterized by being 1100-1300 degrees C.

[Claim 26] The manufacture method of the pottery according to claim 10 to 25 characterized by the amount of contraction of a longitudinal direction being 7% or less at least in the aforementioned baking process.

[Claim 27] The manufacture method of the pottery according to claim 10 to 26 which the amount of deflections when producing a test-piece Plastic solid with width of face 30, a thickness [15], and a length of 260mm in the aforementioned forming cycle, and calcinating on the same baking conditions as pottery in support of this test-piece Plastic solid by span 200mm converts in the baking object thickness of 10mm fairly, and is characterized by being 20mm or less.

[Claim 28] Pottery characterized by the ability to create by the manufacture method of pottery according to claim 10 to 27.

[Claim 29] The aforementioned pottery is SANA of a lavatory, a urinal, a closet, a baby bus, and a toilet bowl, a washhand basin, and pottery according to claim 28 characterized by being either of the toilet bowl tanks.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the pottery represented by a sanitary ware, a tile, tableware, etc. and its manufacture method.

[0002]

[Description of the Prior Art] The base has exposed the pottery product, without forming the cover coat layer only in the required portion of the pottery simple ground, for example, generally, forming a cover coat layer by the legs of the shape of a tile rear face and a circle of tableware, such as the floor installation section of a toilet bowl.

[0003] Therefore, since earthenware generally has water absorption when a base is formed qualitatively of earthenware, water may permeate a base through the above-mentioned base outcrop, and problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion, may arise. Then, conventionally, by making it *****-ize, made the glass phase generate, and the glass phase filled the crevice between the particles in a base, the whole base was made to turn precisely, and the device which abolishes absorptivity has been made.

[0004]

[Problem(s) to be Solved by the Invention] However, passing through such a sintering process made big burning shrinkage and deformation of a base produce, and it had become the cause of worsening the precision of a product size. Namely, although the so-called rate credit of deducing the raw size configuration where the deformation accompanying the amount of burning shrinkage or contraction was taken into consideration was performed in order to obtain the product size made into an aim, since burning shrinkage was large, the variation by the firing environments etc. was also large and needed the correction by grinding etc. depending on the case. this invention is for it to be made in view of the above-mentioned situation, and for a problem not produce the purpose in sanitation sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, not make correction at the time of manufacture, but suppose that offer of pottery with a good precision of a product size is possible also for **.

[0005]

[Means for Solving the Problem] It is the pottery which consists of a cover coat layer formed in a base and the required portion on it that the above-mentioned technical problem should be solved in this invention, the center section of the aforementioned base consists of an earthenware simple ground with absorptivity, and the pottery characterized by for absorptivity to be smaller than the center section of the aforementioned base is offered in the portion in which the cover coat layer is not formed at least among the surface sections of the aforementioned base. In the portion in which the contraction and deformation at the time of baking can be suppressed as much as possible, and it can produce, and the cover coat layer is not formed at least among the surface sections of a base by doing so since the center section of the base is an earthenware simple ground with absorptivity, since absorptivity is smaller than the center section of the aforementioned base, the water absorption in a base outcrop is suppressed and it is hard to

produce problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0006] The center section of the aforementioned base has an ink penetrance larger than 3mm, and it is made be the pottery which consists of a cover coat layer formed in a base and the required portion on it, and for an ink penetrance to be 3mm or less in the desirable mode of this invention, in the portion in which the cover coat layer is not formed at least among the surface sections of the aforementioned base. By doing so, since the center section of the base is the earthenware simple ground where an ink penetrance has absorptivity by 3mm or more and porosity In the portion in which the contraction and deformation at the time of baking can be suppressed as much as possible, and it can produce, and the cover coat layer is not formed at least among the surface sections of a base Since an ink penetrance is 3mm or less, the water absorption from a base outcrop is suppressed and it is hard to produce problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0007] In the desirable mode of this invention the center section of the aforementioned base Composition of the principal component is 245 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 2 or less % of the weight. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, The total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO is 6 or less % of the weight. the surface section of the aforementioned base Composition of the principal component is 2:45 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 5 % of the weight or more. And it is made for there to be more total amounts of at least one sort of alkaline-earth-metal oxides chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O from CaO, MgO, BaO, and BeO than 6 % of the weight. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O about composition of a center section is 2 or less % of the weight. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, By things, generation of a glass phase is suppressed and the deformation accompanying burning shrinkage or it becomes [the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO] making it be 6 or less % of the weight small. And the total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O about composition of the surface section is 5 % of the weight or more. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, By making it there be more total amounts of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO than 6 % of the weight, generation of a glass phase is promoted in the surface section, it turns precisely, and water absorption is suppressed. Therefore, it is hard coming to generate problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0008] It is made for a quartz, a cristobalite, a mullite, and at least one sort of minerals chosen from the group which consists of corundum to contain as a crystal further in the center section of the base in the desirable mode of this invention. The intensity of a base center section improves by doing so.

[0009] It is made for there to be more weight % of Na₂O among the components which constitute the center section of the aforementioned base in the content of an alkali-metal oxide in the desirable mode of this invention than weight % of K₂O. By doing so, since the effect as a sintering acid is [Na] higher than K when advancing surface vitrification consequently, the effect of precise-izing of the surface

section increases.

[0010] It is made for a Na₂O content to be 1 % of the weight or more in the desirable mode of this invention among the components which constitute the center section of the base. By doing so, surface vitrification advances more and the effect of precise-izing of the surface section increases.

[0011] In the desirable mode of this invention, the same base and same cover coat as the aforementioned pottery are used. A ϕ 14x130mm test piece is produced and the test piece is used. by the autograph Span 100mm, The flexural strength computed when a three-point bending test is carried out on condition that crosshead speed 2.5 mm/min is 30 or more MPas. The same base and same cover coat as the aforementioned pottery are used. And width of face of 25mm, thickness of 5mm, Produce a test piece with a length of 230mm and the test piece is supported by two span 200mm points. After carrying out a temperature up to 1000 degrees C in 4 hours, carrying out a temperature up to 1200 more degrees C in 2 hours and holding at 1200 degrees C for 1 hour, it is made for the amount of deflections of the test piece when cooling naturally to a room temperature to be 5mm or less. By doing so, it has intensity usually usable as a product, and baking deformation is small and can obtain the product by which the dimensional accuracy was stabilized.

[0012] It is made for the line coefficient of thermal expansion of the longitudinal direction of the test piece when producing a test piece using the still more nearly same base and cover coat as the aforementioned pottery to be less than $[90 \times 10^{-7} / \text{degree C}]$ in the desirable mode of this invention. Matching with the cover coat currently generally used for the pottery product is good, and it is hard coming to generate fault generating of cover coat sides, such as a glaze jump and intrusion, by doing so. Moreover, the base piece in the cooling process at the time of the baking process of the base itself is suppressed, and a thermal shock resistance improves further.

[0013] The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO₂ and aluminum 2O₃ in the 1 manufacture method of the pottery of this invention, In the aforementioned base raw material, alkali metal, such as water, and Na, K, Li, calcium, Mg, After performing the process which adds alkaline earth metal, such as Ba, and at least one sort of compounds with the dissolved water in fuel containing either of boron one by one, It is made to perform the forming cycle which forms a forming base, the dryness process which dries the aforementioned forming base, the glazing process which applies a cover coat on the aforementioned forming base, and a baking process. By adding and drying at least one sort of compounds after fabrication out of a compound with the dissolved water in fuel containing alkaline earth metal, such as alkali metal, such as Na, K, and Li, and calcium, Mg, Ba, or boron In a dryness process, an alkali-metal oxide component or an alkaline-earth-metal oxide component shifts to a front face simultaneously with moisture, the alkali-metal oxide component or alkaline-earth-metal oxide component of the surface section increases more than a base center section, and, only in the surface section, vitrification becomes easy to advance at the time of baking. While being able to attain precise-ization of the surface section and suppressing the absorptivity of the surface section as a result, it becomes possible to make burning shrinkage of a base center section small.

[0014] In the desirable mode of this invention, in the aforementioned dryness process, in order to move many alkali metal or alkaline earth metal by the predetermined surface section, it is made to perform processing which speeds up the moisture vapor rate from the aforementioned predetermined surface section. By performing processing which speeds up the moisture vapor rate from the predetermined surface section, much alkali metal and alkaline earth metal move by the predetermined surface section, precise-ization of the predetermined surface section is promoted, and the absorptivity of the surface section is suppressed.

[0015] The aforementioned pottery is a closet and it is made for the aforementioned predetermined surface section to be the interior of a trap or a rim in the desirable mode of this invention. By doing so, also inside the interior of a trap which is hard to dry, or a rim, a moisture vapor rate is sped up and the alkali metal or alkaline earth metal of an amount becomes movable to the surface section enough. Therefore, precise-ization of the surface section is promoted, vitrification of the surface section advances, and absorptivity is suppressed.

[0016] The aforementioned pottery is a lavatory and it is made for the aforementioned pottery to be the interior of overflow in the desirable mode of this invention. By doing so, also inside the overflow which is hard to dry, a moisture vapor rate is sped up and the alkali metal or alkaline earth metal of an amount becomes movable to the surface section enough. Therefore, precise-ization of the surface section is promoted, vitrification of the surface section advances, and absorptivity is suppressed.

[0017] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which passes warm air or cold blast in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0018] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which irradiates the heat by source of the radiant heat like an infrared lamp in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0019] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which adds microwave heating and promotes dryness in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0020] It is made for the compound with the aforementioned dissolved water in fuel to be a carbonate, acetate, a sulfate, or a citrate in the desirable mode of this invention. Although a raw material slurry may condense and casting etc. may become difficult if the alkali-metal salt of dissolved water in fuel is added to a raw material slurry, if a carbonate, a sulfate, acetate, and a citrate are used as an alkali-metal salt to add, since it will be hard coming to condense a raw material slurry, it is desirable.

[0021] The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 in other manufacture methods of the pottery of this invention, The process which forms a forming base by fabricating using the aforementioned base raw material, After performing the process dried if needed one by one, on the aforementioned forming base front face Na, Alkaline earth metal, such as alkali metal, such as K and Li, and calcium, Mg, Ba, It is made to perform the application process which applies the solution containing at least one sort of a compound with the dissolved water in fuel containing either of boron to a front face, the process to dry, the glazing process which applies a cover coat on the aforementioned forming base, and the process to calcinate. Thus, the alkali-metal oxide component or alkaline-earth-metal oxide component of the surface section increases more than a base center section, and, only in the surface section, vitrification becomes easy to advance by applying to a front face the solution containing at least one sort of a compound with the dissolved water in fuel which contains alkaline earth metal, such as alkali metal, such as Na, K, and Li, and calcium, Mg, Ba, or boron on a forming base front face in a process after fabrication at the time of baking. While being able to attain precise-ization of the surface section and suppressing the absorptivity of the surface section as a result, it becomes possible to make burning shrinkage of a base center section small.

[0022] It is made for the method of application in the aforementioned application process to be a spraying method using the ultrasonic wave in the desirable mode of this invention. By doing so, it can apply also to a portion like the closet interior of the interior of a trap or a rim, and overflow of a lavatory which is hard to apply easily.

[0023] In the desirable mode of this invention the aforementioned base raw material As an indispensable component of main minerals, a kaolinite, dickite, a halloysite, A sericite, and the argillaceous mineral and quartz which consist of at least one sort chosen from the pyrophyllite are included. At least one sort of minerals chosen from a mullite, corundum, and the diasporite if needed as an arbitrary component are included, and it is made for alkaline-earth-metal content minerals, such as alkali-metal content minerals, dolomites, etc., such as a feldspar, to be included if needed as other components. Holding the moldability by the argillaceous mineral by doing so, a base matrix can be made firm by sinterization of the quartz in a baking process, and the intensity of a base center section can be further raised with the

mullite, the corundum, diaspore mineral or alkaline-earth content mineral as an arbitrary component, and an alkaline-earth-metal content mineral.

[0024] It is made for 1-20 micrometers of mean particle diameters which measure the aforementioned base raw material with a laser diffraction formula particle-size-analysis vessel to be 5-10 micrometers preferably in the desirable mode of this invention. If a mean particle diameter is set to 1 micrometer or less, the state of aggregation of a slurry will become intense, amalgam decomposition will become difficult, and a problem will be produced in a moldability. Moreover, if a mean particle diameter is set to 20 micrometers or more, α -sintering [of a base] cannot become inadequate and sufficient intensity cannot be obtained.

[0025] It is made for the forming method in the aforementioned forming cycle to be slurry casting in the desirable mode of this invention. A dimensional accuracy is good and the large-sized complicated configuration article which can be made to blend easily the alkali-metal salt indispensable to precise-izing or alkaline-earth-metal salt of the surface section into a slurry, and is represented by the sanitary ware according to a thing with that right can be fabricated easily.

[0026] It is made for the burning temperature in the aforementioned baking process to be 1100-1300 degrees C in the desirable mode of this invention. It is possible to have the intensity [say / 30 or more MPas] which is satisfactory practically with flexural strength by the degree baking of high fire of 1100 degrees C - 1300 degrees C, without reducing base intensity extremely. If burning temperature is lower than 1100 degrees C, α -izing of a base and mineralization cannot become inadequate, and the intensity made into an aim cannot be obtained. Since α -sintering will advance too much if higher than 1300 degrees C, it becomes impossible moreover, to obtain the amount of burning shrinkage and deformation which are made into an aim.

[0027] in the desirable mode of this invention, it can set at the aforementioned baking process -- it is made for the amount of contraction of a longitudinal direction to be 7% or less at least By doing so, the variation in the amount of burning shrinkage at the time of a baking process becomes small, and the product by which the dimensional accuracy was stabilized can be obtained.

[0028] The amount of deflections when producing a test-piece Plastic solid with width of face 30, a thickness [15], and a length of 260mm in the aforementioned forming cycle, and calcinating on the same baking conditions as pottery in support of this test-piece Plastic solid by span 200mm converts in the baking object thickness of 10mm fairly, and it is made to be 20mm or less in the desirable mode of this invention. By doing so, the baking deformation at the time of a baking process becomes small, and the product by which the dimensional accuracy was stabilized can be obtained.

[0029]

[Embodiments of the Invention] The example of 1 operation composition of this invention is explained based on drawing 1 below. The cover coat layer 2 is formed in the required portion on a base 1 in this invention. As for the base 1, structures differ in the center section 3 and surface section 4. And a center section 3 consists of an earthenware simple ground with absorptivity, and absorptivity is small rather than the center section 3 in the surface section 4. The composition of the principal component of composition of a center section 3 is 245 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. A quartz, a cristobalite, a mullite, and at least one sort of minerals chosen from the group which consists of corundum contain as a crystal. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 2 or less % of the weight. And the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O from CaO, MgO, BaO, and BeO is 6 or less % of the weight. Moreover, from weight % of K₂O, there is much weight % of Na₂O and it contains 1% of the weight or more to all the oxides that constitute a base. The composition of the principal component of composition of the surface section 4 is 2:45 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. moreover, as other composition

components At least one sort of alkali-metal oxides chosen from the group which consists of Na_2O , K_2O , and Li_2O , and/or CaO , At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO , BaO , and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na_2O , K_2O , and Li_2O is 5 % of the weight or more. And the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na_2O , K_2O , and Li_2O from CaO , MgO , BaO , and BeO is more than 6 % of the weight.

[0030] The flexural strength computed when the pottery of drawing 1 produces a $\phi 14 \times 130 \text{mm}$ test piece using the base and cover coat of the same composition and composition and a three-point bending test is carried out on condition that span 100mm and crosshead speed 2.5 mm/min by the autograph using the test piece is 30 or more MPas. Moreover, after produce a test piece with width of face of 25mm, a thickness [of 5mm], and a length of 230mm, supporting the test piece by two span 200mm points using the base and cover coat of the same composition as pottery, and composition, carrying out a temperature up to 1000 degrees C in 4 hours, carrying out a temperature up to 1200 more degrees C in 2 hours and holding at 1200 degrees C for 1 hour, the amount of deflections of the test piece when cooling naturally to a room temperature is 5mm or less. Furthermore, the line coefficient of thermal expansion of the longitudinal direction of the test piece when producing a test piece using the base and cover coat of the same composition as pottery and composition is less than $[90 \times 10^{-7} / \text{degree C }]$.

[0031] A problem does not arise in health sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, the above-mentioned pottery does not make correction at the time of manufacture, but the precision of ** of a product size is [the pottery] good. Therefore, it can use for SANA of a lavatory, a urinal, a closet, a baby bus, and a toilet bowl, a washhand basin, a toilet bowl tank, etc. broadly.

[0032] The pottery of drawing 1 is producible by two methods shown below.

(1) The base manufacture process which produces a base [in which the mean particle diameter which performs grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 , and is measured with a laser diffraction formula particle-size-analysis vessel is 1-20 micrometers] raw material, In the aforementioned base raw material, alkali metal, such as water, and Na, K, Li, calcium, Mg, After performing the process which adds alkaline earth metal, such as Ba, and at least one sort of compounds with the dissolved water in fuel containing either of boron one by one, A baking process is performed at the forming cycle which forms a forming base by methods, such as slurry casting, the dryness process which dries the aforementioned forming base, the glazing process which applies a cover coat on the aforementioned forming base, and the temperature of 1100-1300 degrees C.

(2) The base manufacture process which produces a base [in which the mean particle diameter which performs grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 , and is measured with a laser diffraction formula particle-size-analysis vessel is 1-20 micrometers] raw material, The process which forms a forming base by fabricating by methods, such as slurry casting, using the aforementioned base raw material, After performing the process dried if needed one by one, on the aforementioned forming base front face Na, Alkaline earth metal, such as alkali metal, such as K and Li, and calcium, Mg, Ba, The application process which applies the solution containing at least one sort of a compound with the dissolved water in fuel containing either of boron to a front face, the process to dry, the glazing process which applies a cover coat on the aforementioned forming base, and the process calcinated at the temperature of 1100-1300 degrees C are performed.

[0033] In the method of (1), a slurry cannot condense the compound with dissolved water in fuel easily as they are a carbonate, acetate, a sulfate, or a citrate, and although it is desirable, if a sulfate, a nitrate, a hydroxide, a metal complex, etc. are the alkali-metal salts of dissolved water in fuel, otherwise, it is usable. Moreover, in a dryness process, in order to move many alkali metal or alkaline earth metal by the surface section 4, it is desirable to perform processing which speeds up the moisture vapor rate from the surface section 4. As the concrete method, the method of passing warm air or cold blast, the method of irradiating the heat by source of the radiant heat like an infrared lamp, and microwave heating can be added, and the method of promoting dryness etc. can use suitably.

[0034] dipping for which the method of application is generally used in the method of (2), brush coating, roller coating, and a trowel -- although it is possible to use coating, an atomizer, a spray, etc., to the part which is hard to apply, an ultrasonic spraying method is desirable

[0035] When pottery is produced by the method of (1) and (2), at a baking process A test-piece Plastic solid with the width of face 30 which the amount of contraction of a longitudinal direction comes to be 7% or less at least, and produced even the process before dryness on the same conditions as pottery, a thickness [15], and a length of 260mm is supported by span 200mm. The amount of deflections when calcinating on the same baking conditions as pottery converts in the baking object thickness of 10mm fairly, and comes to be 20mm or less.

[0036] Next, it explains to a detail further about some of words which come out on these specifications. After the surface section fabrication-dries and calcinates a base, it shows the range which can be analyzed from a front face by the surface-chemistry component-analysis devices (for example, 3270 made from X-ray fluorescence equipment physical science electrical machinery etc.) currently generally used, and the range of it is usually several 10 micrometers in the thickness direction from a front face. Moreover, a base center section cuts a sintered compact in the thickness direction, and shows the part of a front face and a rear face which hits near a center mostly.

[0037] A ceramic industry raw material points to the both sides of the raw material currently used as a usual *-ized simple ground raw material, and the raw material currently used as a refractories raw material. Here, *-ized simple ground raw materials are a pottery stone, a feldspar, silica, a mica, a kaolin, frog clay, kibushi clay, a dolomite, etc., and refractories raw materials are agalmatolite, a van soil shale, a chamotte, agalmatolite clay, fire clay, a flint clay, a bauxite, a magnesia clinker, etc. As for a *-ized simple ground raw material and a refractories raw material, using together is desirable. It is because it is easy for the way which made refractories raw materials, such as agalmatolite with an alkali-metal oxide and alkaline-earth-metal oxide content lower than the case where a base is prepared by composition of only a *-ized simple ground raw material, and a chamotte raw material, use together to decrease the alkali-metal oxide and alkaline-earth-metal oxide in a base.

[0038] An ultrasonic formula sprayer is an ultrasonic formula humidifier, an ultrasonic formula inhalator, etc. which are generally marketed, and it is important that-izing of the solution can be carried out [Myst] where alkali metal or alkaline earth metal is included. The interior of the complicated configuration in what has constituted tube configurations, such as a trap, just because it is Myst, or a rim etc. can be permeated.

[0039]

[Example] Base preparation and the chemical composition of the example of this invention and the example of comparison, and a crystal mineral are shown in drawing 2 . The base manufacture method carried out wet grinding of what carried out weighing capacity of the predetermined raw material, and carried out proper quantity addition of the silicate of soda as the water 35 section and a deflocculant in the pot mill, and prepared the mean particle diameter to 6 micrometers. Here, since it said that the cohesiveness of a raw material slurry was the lowest as an alkali-metal salt contributed to surface precise-ization, the alkali-metal citrate was chosen and the lithium citrate, the sodium citrate, and the potassium citrate were used. Moreover, although it is the addition method of an alkali-metal salt, after carrying out grain refining only of the method and base raw material which are added by package simultaneously with base raw material, either of the method of back-adding an alkali-metal salt is applicable. In addition, about the alkali-metal salt to add, it is not what was limited above, and otherwise, if a carbonate, a sulfate, acetate, a nitrate, a hydroxide, a metal complex, etc. are the alkali-metal salts of dissolved water in fuel, it is usable. Next, the raw material slurry was slushed into the plaster mold which can be fabricated in the predetermined configuration of the sample for physical-properties measurement, it unmolded after impression fabrication, and the test piece was fabricated. It calcinated by the heat curve which carries out it to 1000 degrees C with an electric furnace after a test piece carries out 24hr dryness at 40 degrees C, and carries out a temperature up to 1200 degrees C in 2 hours for 4 hours and which is cooled naturally after 1-hour maintenance at 1200 degrees C. Here, in an example, since it is the sample base, 40-degree C regular dryness is altogether enough as the

manifestation of an effect. However, a thing [promoting the moisture vapor rate from a front face about the part which is hard to dry like and by using cold blast, hot blast, infrared radiation, microwave, etc., in order to deposit alkali metal or alkaline earth metal mostly to the field which an alkali-metal salt or an alkaline-earth-metal salt wants to deposit] according to claim 9 to 12 is desirable.

[0040] Here, it is applicable, if it is the forming method in the state where moisture was otherwise contained at the time of fabrication, such as extrusion molding, spinning lathe fabrication, and wet pressing, as a forming cycle, although slurry casting is raised to the example. Moreover, since an alkali-metal salt cannot be added, although the manufacture method according to claim 8 which carries out alkali-metal salt addition is inapplicable by dry pressing methods, such as powder press forming, it is possible to apply the manufacture method which applies an alkali-metal salt to the Plastic-solid surface section according to claim 14.

[0041] Base flexural strength is the value measured by the $\phi 14 \times 130$ mm test piece by the method of bending three points on condition that span 100mm and crosshead speed 2.5 mm/min by the Shimazu autograph.

[0042] Baking deformation supports the test piece (base in which it does not calcinate) with width of face 30, a thickness [15], and a length of 260mm, by span 200mm at the time of baking, and is the value which measured the amount of deflections after baking, and the thickness of a test piece. Since the amount of deflections at this time is in inverse proportion to the square of the thickness of the test piece after baking, it makes deformation the amount of deflections converted when thickness was 10mm by the following formula.

Amount measured-value of baking deformation = deflections (thickness of test piece after baking)

2/102[0043] The deformation at the time of reheating supports a test piece (baking base) with width of face of 25mm, a thickness [of 5mm], and a length of 230mm by two span 200mm points, it carries out a temperature up to 1000 degrees C in 4 hours, and it carries out a temperature up to 1200 more degrees C in 2 hours, and after holding at 1200 degrees C for 1 hour, it makes the amount of deflections of the test piece when cooling naturally to a room temperature the deformation at the time of reheating. However, about the case where the thickness of a test piece is not 5mm, the amount of deflections makes the value amended since it was in inverse proportion to the thickness of a test piece the deformation at the time of reheating. The amendment method surveys deformation at the time of reheating by the test piece of two kinds of different thickness, computes n by the following formula, and calculates the deformation at the time of reheating in case the thickness of a test piece is 5mm further.

deformation 2 = deformation 1 \times (1/thickness 2 of thickness) n deformation 1: -- deformation deformation 2: at the time of reheating by the test piece of thickness 1 -- deformation n: at the time of reheating by the test piece of thickness 2 -- the constant for amendment [0044] It substitutes for the base fracture surface as ink penetrances other than the surface section. After carrying out about the measuring method according to JISA5207, making a test piece with width of face 30, a thickness [15], and a length of 130mm fracture, making the fracture surface immersed for 1 hour or more in a red ink solution (eosine Y solution of 1% of concentration) and wiping off ink, it is the value which measured the maximum osmosis size which permeated in the base.

[0045] A surface section ink penetrance Width of face 30, thickness 15, the rear face of a test piece with a length of 130mm, So that red ink may not permeate the portion which precise-ization, such as a cross section, has not accomplished Paraffin, After carrying out filling by the resin etc., and the surface section makes it immersed for 1 hour or more in the red ink solution (eosine Y solution of 1% of concentration) of an amount immersed enough and wipes off ink, it is the value which measured the maximum osmosis size which fractured the sample and permeated in the base.

[0046] The physical properties and chemical analysis of an example and the example of comparison are shown in drawing 3 . The example 1 of comparison is general *-ized simple ground composition, and since sintering is advancing completely, the fracture surface and the surface section of an ink penetrance are 0.1mm. However, it turns out that burning shrinkage and deformation show the biggest value. The example 2 of comparison is the composition which substituted for the feldspar with which many sintering-acid components are contained, and the dolomite from the example 1 of comparison to the

kaolin. The amount of an alkali-metal oxide is 2 % of the weight or more, burning shrinkage and deformation are still large, and an ink penetrance is in the state where the water absorption from a front face cannot be prevented at all, in 8.0mm. The example 3 of comparison is the case where refractories raw materials, such as a chamotte, are used together, and is the preparation which decreased the amount of alkali-metal oxides of the base itself, and the amount of alkaline-earth-metal oxides as much as possible. In this case, 3.9%, a burning shrinkage is 4.3mm in deformation, and is quite small. However, since the alkali-metal salt is not added, especially, the alkali-metal oxide content of the surface section does not become high, either, and cannot be attaining surface precise-ization.

[0047] An example 1 adds an alkali-metal salt 0.4% in a total amount for the example 2 of comparison. In this base composition, the surface section alkali-metal oxide content indicates the high value to be 5.2%, consequently precise-ization of the surface section can be attained, and the ink penetrance has become 0.1mm. However, the amount of the alkali-metal oxide of the base itself is 2 % of the weight or more, and has become height a little about burning shrinkage and deformation. An example 2 adds an alkali-metal salt 0.3% in a total amount for the example 3 of comparison. The alkali-metal oxide content of the surface section is high according to it. However, since it is about 3.8%, although the absorptivity from a front face is quite small rather than the example 3 of comparison, an ink penetrance is 3.5mm and is higher a little.

[0048] An example 3 adds an alkali-metal salt 0.6% in a total amount for the example 3 of comparison. In spite of being very small with the burning shrinkage of 4.4%, and the deformation of 4.4mm, a surface ink penetrance is 0.1mm. This is the result of vitrification of the surface section advancing, since the alkali-metal oxide content of the surface section was very high with 7.2%. An example 4 changes the addition ratio of an alkali-metal salt, and changes it to 0.4% in a total amount. Also with this addition, the alkali-metal oxide content of the surface section shows 6.8% and the high value, and has obtained the good result by 0.2mm of ink penetrances. An example 5 makes [more] the inner Na₂O component of an alkali-metal oxide base component in preparation of an example 2 than a K₂O component. Although the whole burning shrinkage is almost changeless, surface precise metaplasia is improving and the ink penetrance has become 2.0mm. Moreover, although an example 6 makes a Na₂O component increase further, about this, the ink penetrance has brought 0.5mm and a still better result. Thus, it is possible to raise the effect of surface precise metaplasia also by selection of the alkali-metal oxide component as a sintering acid among the components which constitute a base.

[0049] An example 7 slushes an example of comparison 3 composition slurry into a plaster mold, and brush coating of the sodium-citrate solution is carried out to a sample front face 20% after a sludge, and it is dried and calcinated. Moreover, an example 8 creates a sample by the same forming method as an example 7, and it carries out dipping for 1 minute into 20% potassium-citrate solution. Moreover, an example 9 creates a sample by the same forming method as an example 7, and sprays a sodium citrate on a sample front face for 10 minutes 20% by the ultrasonic spraying method. The alkali-metal content of the surface section became 5.7%, 6.8%, and 6.5%, respectively, and all ink penetrances have obtained 0.1mm and the good result. Moreover, other physical-properties values, such as a burning shrinkage, deformation, and flexural strength, show the example 3 of comparison, and the value practically equal. The alkali-metal salt water solution shown in examples 7-9 is not limited to sodium-citrate solution and potassium-citrate solution, and even if they are which alkali-metal salt water solutions, such as a sulfate, acetate, a hydroxide solution, and a complex solution, it gives the same effect. moreover -- although it is the method of application of the alkali-metal salt to a front face -- others -- an atomizer application, a spray application, and a trowel -- the same effect can be given also by methods, such as coating and roller coating

[0050]

[Effect of the Invention] According to this invention, a problem cannot arise in health sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, and correction cannot be made at the time of manufacture, but suppose that offer of pottery with a good precision of a product size is possible also for **.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the pottery represented by a sanitary ware, a tile, tableware, etc. and its manufacture method.

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PRIOR ART

[Description of the Prior Art] The base has exposed the pottery product, without forming the cover coat layer only in the required portion of the pottery simple ground, for example, generally, forming a cover coat layer by the legs of the shape of a tile rear face and a circle of tableware, such as the floor installation section of a toilet bowl.

[0003] Therefore, since earthenware generally has water absorption when a base is formed qualitatively of earthenware, water may permeate a base through the above-mentioned base outcrop, and problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion, may arise. Then, conventionally, by making it *****-ize, made the glass phase generate, and the glass phase filled the crevice between the particles in a base, the whole base was made to turn precisely, and the device which abolishes absorptivity has been made.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, a problem cannot arise in health sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, and correction cannot be made at the time of manufacture, but suppose that offer of pottery with a good precision of a product size is possible also for **.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, passing through such a sintering process made big burning shrinkage and deformation of a base produce, and it had become the cause of worsening the precision of a product size. Namely, although the so-called rate credit of deducing the raw size configuration where the deformation accompanying the amount of burning shrinkage or contraction was taken into consideration was performed in order to obtain the product size made into an aim, since burning shrinkage was large, the variation by the firing environments etc. was also large and needed the correction by grinding etc. depending on the case. this invention is for it to be made in view of the above-mentioned situation, and for a problem not produce the purpose in health sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, not make correction at the time of manufacture, but suppose that offer of pottery with a good precision of a product size is possible also for **.

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MEANS

[Means for Solving the Problem] It is the pottery which consists of a cover coat layer formed in a base and the required portion on it that the above-mentioned technical problem should be solved in this invention, the center section of the aforementioned base consists of an earthenware simple ground with absorptivity, and the pottery characterized by for absorptivity to be smaller than the center section of the aforementioned base is offered in the portion in which the cover coat layer is not formed at least among the surface sections of the aforementioned base. In the portion in which the contraction and deformation at the time of baking can be suppressed as much as possible, and it can produce, and the cover coat layer is not formed at least among the surface sections of a base by doing so since the center section of the base is an earthenware simple ground with absorptivity, since absorptivity is smaller than the center section of the aforementioned base, the water absorption in a base outcrop is suppressed and it is hard to produce problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0006] The center section of the aforementioned base has an ink penetrance larger than 3mm, and it is made be the pottery which consists of a cover coat layer formed in a base and the required portion on it, and for an ink penetrance to be 3mm or less in the desirable mode of this invention, in the portion in which the cover coat layer is not formed at least among the surface sections of the aforementioned base. By doing so, since the center section of the base is the earthenware simple ground where an ink penetrance has absorptivity by 3mm or more and porosity In the portion in which the contraction and deformation at the time of baking can be suppressed as much as possible, and it can produce, and the cover coat layer is not formed at least among the surface sections of a base Since an ink penetrance is 3mm or less, the water absorption from a base outcrop is suppressed and it is hard to produce problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0007] In the desirable mode of this invention the center section of the aforementioned base Composition of the principal component is 245 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 2 or less % of the weight. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, The total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO is 6 or less % of the weight. the surface section of the aforementioned base Composition of the principal component is 2:45 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 5 % of the weight or more. And it is made for there to be more total amounts of at least one sort of alkaline-earth-metal oxides

chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O from CaO, MgO, BaO, and BeO than 6 % of the weight. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O about composition of a center section is 2 or less % of the weight. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, By things, generation of a glass phase is suppressed and the deformation accompanying burning shrinkage or it becomes [the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO] making it be 6 or less % of the weight small. And the total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O about composition of the surface section is 5 % of the weight or more. And at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O and CaO, By making it there be more total amounts of at least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO than 6 % of the weight, generation of a glass phase is promoted in the surface section, it turns precisely, and water absorption is suppressed. Therefore, it is hard coming to generate problems, such as a frost damage in delayed crazing and the cold district by the moisture expansion.

[0008] It is made for a quartz, a cristobalite, a mullite, and at least one sort of minerals chosen from the group which consists of corundum to contain as a crystal further in the center section of the base in the desirable mode of this invention. The intensity of a base center section improves by doing so.

[0009] It is made for there to be more weight % of Na₂O among the components which constitute the center section of the aforementioned base in the content of an alkali-metal oxide in the desirable mode of this invention than weight % of K₂O. By doing so, since the effect as a sintering acid is [Na] higher than K when advancing surface vitrification consequently, the effect of precise-izing of the surface section increases.

[0010] It is made for a Na₂O content to be 1 % of the weight or more in the desirable mode of this invention among the components which constitute the center section of the base. By doing so, surface vitrification advances more and the effect of precise-izing of the surface section increases.

[0011] In the desirable mode of this invention, the same base and same cover coat as the aforementioned pottery are used. A $\phi 14 \times 130$ mm test piece is produced and the test piece is used. by the autograph Span 100mm, The flexural strength computed when a three-point bending test is carried out on condition that crosshead speed 2.5 mm/min is 30 or more MPas. The same base and same cover coat as the aforementioned pottery are used. And width of face of 25mm, thickness of 5mm, Produce a test piece with a length of 230mm and the test piece is supported by two span 200mm points. After carrying out a temperature up to 1000 degrees C in 4 hours, carrying out a temperature up to 1200 more degrees C in 2 hours and holding at 1200 degrees C for 1 hour, it is made for the amount of deflections of the test piece when cooling naturally to a room temperature to be 5mm or less. By doing so, it has intensity usually usable as a product, and baking deformation is small and can obtain the product by which the dimensional accuracy was stabilized.

[0012] It is made for the line coefficient of thermal expansion of the longitudinal direction of the test piece when producing a test piece using the still more nearly same base and cover coat as the aforementioned pottery to be less than [$90 \times 10^{-7} / \text{degree C}$] in the desirable mode of this invention. Matching with the cover coat currently generally used for the pottery product is good, and it is hard coming to generate fault generating of cover coat sides, such as a glaze jump and intrusion, by doing so. Moreover, the base piece in the cooling process at the time of the baking process of the base itself is suppressed, and a thermal shock resistance improves further.

[0013] The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO₂ and aluminum 2O₃ in the 1 manufacture method of the pottery of this invention, In the aforementioned base raw material, alkali metal, such as water, and Na, K, Li, calcium, Mg, After performing the process which adds alkaline earth metal, such as Ba, and at least one sort of compounds with the dissolved water in fuel containing either of boron one by one, It is made to perform the forming cycle which forms a forming base, the

dryness process which dries the aforementioned forming base, the glazing process which applies a cover coat on the aforementioned forming base, and a baking process. By adding and drying at least one sort of compounds after fabrication out of a compound with the dissolved water in fuel containing alkaline earth metal, such as alkali metal, such as Na, K, and Li, and calcium, Mg, Ba, or boron. In a dryness process, an alkali-metal oxide component or an alkaline-earth-metal oxide component shifts to a front face simultaneously with moisture, the alkali-metal oxide component or alkaline-earth-metal oxide component of the surface section increases more than a base center section, and, only in the surface section, vitrification becomes easy to advance at the time of baking. While being able to attain precise-ization of the surface section and suppressing the absorptivity of the surface section as a result, it becomes possible to make burning shrinkage of a base center section small.

[0014] In the desirable mode of this invention, in the aforementioned dryness process, in order to move many alkali metal or alkaline earth metal by the predetermined surface section, it is made to perform processing which speeds up the moisture vapor rate from the aforementioned predetermined surface section. By performing processing which speeds up the moisture vapor rate from the predetermined surface section, much alkali metal and alkaline earth metal move by the predetermined surface section, precise-ization of the predetermined surface section is promoted, and the absorptivity of the surface section is suppressed.

[0015] The aforementioned pottery is a closet and it is made for the aforementioned predetermined surface section to be the interior of a trap or a rim in the desirable mode of this invention. By doing so, also inside the interior of a trap which is hard to dry, or a rim, a moisture vapor rate is sped up and the alkali metal or alkaline earth metal of an amount becomes movable to the surface section enough. Therefore, precise-ization of the surface section is promoted, vitrification of the surface section advances, and absorptivity is suppressed.

[0016] The aforementioned pottery is a lavatory and it is made for the aforementioned pottery to be the interior of overflow in the desirable mode of this invention. By doing so, also inside the overflow which is hard to dry, a moisture vapor rate is sped up and the alkali metal or alkaline earth metal of an amount becomes movable to the surface section enough. Therefore, precise-ization of the surface section is promoted, vitrification of the surface section advances, and absorptivity is suppressed.

[0017] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which passes warm air or cold blast in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0018] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which irradiates the heat by source of the radiant heat like an infrared lamp in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0019] In order that the aforementioned processing may move many alkali metal or alkaline earth metal by the front face to the field to which you want to move alkali metal or alkaline earth metal, it is made to be processing which adds microwave heating and promotes dryness in the desirable mode of this invention. By doing so, it can process easily also to the above parts which are hard to dry.

[0020] It is made for the compound with the aforementioned dissolved water in fuel to be a carbonate, acetate, a sulfate, or a citrate in the desirable mode of this invention. Although a raw material slurry may condense and casting etc. may become difficult if the alkali-metal salt of dissolved water in fuel is added to a raw material slurry, if a carbonate, a sulfate, acetate, and a citrate are used as an alkali-metal salt to add, since it will be hard coming to condense a raw material slurry, it is desirable.

[0021] The base manufacture process which produces a base raw material by performing grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 in other manufacture methods of the pottery of this invention, The process which forms a forming base by fabricating using the aforementioned base raw material, After performing the process dried if needed one by one, on the aforementioned forming base front face Na, Alkaline earth metal, such as alkali

metal, such as K and Li, and calcium, Mg, Ba, It is made to perform the application process which applies the solution containing at least one sort of a compound with the dissolved water in fuel containing either of boron to a front face, the process to dry, the glazing process which applies a cover coat on the aforementioned forming base, and the process to calcinate. Thus, the alkali-metal oxide component or alkaline-earth-metal oxide component of the surface section increases more than a base center section, and, only in the surface section, vitrification becomes easy to advance by applying to a front face the solution containing at least one sort of a compound with the dissolved water in fuel which contains alkaline earth metal, such as alkali metal, such as Na, K, and Li, and calcium, Mg, Ba, or boron on a forming base front face in a process after fabrication at the time of baking. While being able to attain precise-ization of the surface section and suppressing the absorptivity of the surface section as a result, it becomes possible to make burning shrinkage of a base center section small.

[0022] It is made for the method of application in the aforementioned application process to be a spraying method using the ultrasonic wave in the desirable mode of this invention. By doing so, it can apply also to a portion like the closet interior of the interior of a trap or a rim, and overflow of a lavatory which is hard to apply easily.

[0023] In the desirable mode of this invention the aforementioned base raw material As an indispensable component of main minerals, a kaolinite, dickite, a halloysite, A sericite, and the argillaceous mineral and quartz which consist of at least one sort chosen from the pyrophyllite are included. At least one sort of minerals chosen from a mullite, corundum, and the diaspore if needed as an arbitrary component are included, and it is made for alkaline-earth-metal content minerals, such as alkali-metal content minerals, dolomites, etc., such as a feldspar, to be included if needed as other components. Holding the moldability by the argillaceous mineral by doing so, a base matrix can be made firm by ** -ization of the quartz in a baking process, and the intensity of a base center section can be further raised with the mullite, the corundum, diaspore mineral or alkaline-earth content mineral as an arbitrary component, and an alkaline-earth-metal content mineral.

[0024] It is made for 1-20 micrometers of mean particle diameters which measure the aforementioned base raw material with a laser diffraction formula particle-size-analysis vessel to be 5-10 micrometers preferably in the desirable mode of this invention. If a mean particle diameter is set to 1 micrometer or less, the state of aggregation of a slurry will become intense, amalgam decomposition will become difficult, and a problem will be produced in a moldability. Moreover, if a mean particle diameter is set to 20 micrometers or more, ** -ized sintering [of a base] cannot become inadequate and sufficient intensity cannot be obtained.

[0025] It is made for the forming method in the aforementioned forming cycle to be slurry casting in the desirable mode of this invention. A dimensional accuracy is good and the large-sized complicated configuration article which can be made to blend easily the alkali-metal salt indispensable to precise-izing or alkaline-earth-metal salt of the surface section into a slurry, and is represented by the sanitary ware according to a thing with that right can be fabricated easily.

[0026] It is made for the burning temperature in the aforementioned baking process to be 1100-1300 degrees C in the desirable mode of this invention. It is possible to have the intensity [say / 30 or more MPas] which is satisfactory practically with flexural strength by the degree baking of high fire of 1100 degrees C - 1300 degrees C, without reducing base intensity extremely. Burning temperature cannot become inadequate [** -izing of a low and a base and mineralization] from 1100 degrees C, and the intensity made into an aim cannot be obtained. Since ** -ized sintering will advance too much if higher than 1300 degrees C, it becomes impossible moreover, to obtain the amount of burning shrinkage and deformation which are made into an aim.

[0027] in the desirable mode of this invention, it can set at the aforementioned baking process -- it is made for the amount of contraction of a longitudinal direction to be 7% or less at least By doing so, the variation in the amount of burning shrinkage at the time of a baking process becomes small, and the product by which the dimensional accuracy was stabilized can be obtained.

[0028] The amount of deflections when producing a test-piece Plastic solid with width of face 30, a thickness [15], and a length of 260mm in the aforementioned forming cycle, and calcinating on the

same baking conditions as pottery in support of this test-piece Plastic solid by span 200mm converts in the baking object thickness of 10mm fairly, and it is made to be 20mm or less in the desirable mode of this invention. By doing so, the baking deformation at the time of a baking process becomes small, and the product by which the dimensional accuracy was stabilized can be obtained.

[0029]

[Embodiments of the Invention] The example of 1 operation composition of this invention is explained based on drawing 1 below. The cover coat layer 2 is formed in the required portion on a base 1 in this invention. As for the base 1, structures differ in the center section 3 and surface section 4. And a center section 3 consists of an earthenware simple ground with absorptivity, and absorptivity is small rather than the center section 3 in the surface section 4. The composition of the principal component of composition of a center section 3 is 245 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. A quartz, a cristobalite, a mullite, and at least one sort of minerals chosen from the group which consists of corundum contain as a crystal. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 2 or less % of the weight. And the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O from CaO, MgO, BaO, and BeO is 6 or less % of the weight. Moreover, from weight % of K₂O, there is much weight % of Na₂O and it contains 1% of the weight or more to all the oxides that constitute a base. The composition of the principal component of composition of the surface section 4 is 2:45 - 70 % of the weight of SiO(s), and 2O3:25 - 50 % of the weight of aluminum. moreover, as other composition components At least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O, and/or CaO, At least one sort of alkaline-earth-metal oxides chosen from the group which consists of MgO, BaO, and BeO are included. The total amount of at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O is 5 % of the weight or more. And the total amount of at least one sort of alkaline-earth-metal oxides chosen from the group which serves as at least one sort of alkali-metal oxides chosen from the group which consists of Na₂O, K₂O, and Li₂O from CaO, MgO, BaO, and BeO is more than 6 % of the weight.

[0030] The flexural strength computed when the pottery of drawing 1 produces a phi14x130mm test piece using the base and cover coat of the same composition and composition and a three-point bending test is carried out on condition that span 100mm and crosshead speed 2.5 mm/min by the autograph using the test piece is 30 or more MPas. Moreover, after produce a test piece with width of face of 25mm, a thickness [of 5mm], and a length of 230mm, supporting the test piece by two span 200m points using the base and cover coat of the same composition as pottery, and composition, carrying out a temperature up to 1000 degrees C in 4 hours, carrying out a temperature up to 1200 more degrees C in 2 hours and holding at 1200 degrees C for 1 hour, the amount of deflections of the test piece when cooling naturally to a room temperature is 5mm or less. Furthermore, the line coefficient of thermal expansion of the longitudinal direction of the test piece when producing a test piece using the base and cover coat of the same composition as pottery and composition is less than [$90 \times 10^{-7} / \text{degree C}$].

[0031] A problem does not arise in sanitation sides, such as delayed crazing by the moisture expansion, a frost damage, and contamination, the above-mentioned pottery does not make correction at the time of manufacture, but the precision of ** of a product size is [the pottery] good. Therefore, it can use for SANA of a lavatory, a urinal, a closet, a baby bus, and a toilet bowl, a washhand basin, a toilet bowl tank, etc. broadly.

[0032] The pottery of drawing 1 is producible by two methods shown below.

(1) The base manufacture process which produces a base [in which the mean particle diameter which performs grain refining of the ceramic industry raw material which makes a principal component SiO₂ and aluminum 2O₃, and is measured with a laser diffraction formula particle-size-analysis vessel is 1-20 micrometers] raw material, In the aforementioned base raw material, alkali metal, such as water, and

Na, K, Li, calcium, Mg, After performing the process which adds alkaline earth metal, such as Ba, and at least one sort of compounds with the dissolved water in fuel containing either of boron one by one, A baking process is performed at the forming cycle which forms a forming base by methods, such as slurry casting, the dryness process which dries the aforementioned forming base, the glazing process which applies a cover coat on the aforementioned forming base, and the temperature of 1100-1300 degrees C.

(2) The base manufacture process which produces a base [in which the mean particle diameter which performs grain refining of the ceramic industry raw material which makes a principal component SiO_2 and aluminum 2O_3 , and is measured with a laser diffraction formula particle-size-analysis vessel is 1-20 micrometers] raw material, The process which forms a forming base by fabricating by methods, such as slurry casting, using the aforementioned base raw material, After performing the process dried if needed one by one, on the aforementioned forming base front face Na, Alkaline earth metal, such as alkali metal, such as K and Li, and calcium, Mg, Ba, The application process which applies the solution containing at least one sort of a compound with the dissolved water in fuel containing either of boron to a front face, the process to dry, the glazing process which applies a cover coat on the aforementioned forming base, and the process calcinated at the temperature of 1100-1300 degrees C are performed.

[0033] In the method of (1), a slurry cannot condense the compound with dissolved water in fuel easily as they are a carbonate, acetate, a sulfate, or a citrate, and although it is desirable, if a sulfate, a nitrate, a hydroxide, a metal complex, etc. are the alkali-metal salts of dissolved water in fuel, otherwise, it is usable. Moreover, in a dryness process, in order to move many alkali metal or alkaline earth metal by the surface section 4, it is desirable to perform processing which speeds up the moisture vapor rate from the surface section 4. As the concrete method, the method of passing warm air or cold blast, the method of irradiating the heat by source of the radiant heat like an infrared lamp, and microwave heating can be added, and the method of promoting dryness etc. can use suitably.

[0034] dipping for which the method of application is generally used in the method of (2), brush coating, roller coating, and a trowel -- although it is possible to use coating, an atomizer, a spray, etc., to the part which is hard to apply, an ultrasonic spraying method is desirable

[0035] When pottery is produced by the method of of (1) and (2), at a baking process A test-piece Plastic solid with the width of face 30 which the amount of contraction of a longitudinal direction comes to be 7% or less at least, and produced even the process before dryness on the same conditions as pottery, a thickness [15], and a length of 260mm is supported by span 200mm. The amount of deflections when calcinating on the same baking conditions as pottery converts in the baking object thickness of 10mm fairly, and comes to be 20mm or less.

[0036] Next, it explains to a detail further about some of words which come out on these specifications. After the surface section fabrication-dries and calcinates a base, it shows the range which can be analyzed from a front face by the surface-chemistry component-analysis devices (for example, 3270 made from X-ray fluorescence equipment physical science electrical machinery etc.) currently generally used, and the range of it is usually several 10 micrometers in the thickness direction from a front face. Moreover, a base center section cuts a sintered compact in the thickness direction, and shows the part of a front face and a rear face which hits near a center mostly.

[0037] A ceramic industry raw material points to the both sides of the raw material currently used as a usual *-ized simple ground raw material, and the raw material currently used as a refractories raw material. Here, *-ized simple ground raw materials are a pottery stone, a feldspar, silica, a mica, a kaolin, frog clay, kibushi clay, a dolomite, etc., and refractories raw materials are agalmatolite, a van soil shale, a chamotte, agalmatolite clay, fire clay, a flint clay, a bauxite, a magnesia clinker, etc. As for a *-ized simple ground raw material and a refractories raw material, using together is desirable. It is because it is easier than the case where a base is prepared by composition of only a *-ized simple ground raw material for the way where an alkali-metal oxide and alkaline-earth-metal oxide content made refractories raw materials, such as low agalmatolite and a chamotte raw material, use together to decrease the alkali-metal oxide and alkaline-earth-metal oxide in a base.

[0038] An ultrasonic formula sprayer is an ultrasonic formula humidifier, an ultrasonic formula inhalator, etc. which are generally marketed, and it is important that-izing of the solution can be carried

out [Myst] where alkali metal or alkaline earth metal is included. The interior of the complicated configuration in what has constituted tube configurations, such as a trap, just because it is Myst, or a rim etc. can be permeated.

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EXAMPLE

[Example] Base preparation and the chemical composition of the example of this invention and the example of comparison, and a crystal mineral are shown in drawing 2. The base manufacture method carried out wet grinding of what carried out weighing capacity of the predetermined raw material, and carried out optimum dose addition of the silicate of soda as the water 35 section and a deflocculant in the pot mill, and prepared the mean particle diameter to 6 micrometers. Here, as an alkali-metal salt contributed to surface precise-ization, since the cohesiveness of a raw material slurry called it the low most, the alkali-metal citrate was chosen and the lithium citrate, the sodium citrate, and the potassium citrate were used. Moreover, although it is the addition method of an alkali-metal salt, after carrying out grain refining only of the method and base raw material which are added by package simultaneously with base raw material, either of the method of back-adding an alkali-metal salt is applicable. In addition, about the alkali-metal salt to add, it is not what was limited above, and otherwise, if a carbonate, a sulfate, acetate, a nitrate, a hydroxide, a metal complex, etc. are the alkali-metal salts of dissolved water in fuel, it is usable. Next, the raw material slurry was slushed into the plaster mold which can be fabricated in the predetermined configuration of the sample for physical-properties measurement, it unmolded after impression fabrication, and the test piece was fabricated. It calcinated by the heat curve which carries out it to 1000 degrees C with an electric furnace after a test piece carries out 24hr dryness at 40 degrees C, and carries out a temperature up to 1200 degrees C in 2 hours for 4 hours and which is cooled naturally after 1-hour maintenance at 1200 degrees C. Here, in an example, since it is the sample base, 40-degree C regular dryness is altogether enough as the manifestation of an effect. However, a thing [promoting the moisture vapor rate from a front face about the part which is hard to dry like and by using cold blast, hot blast, infrared radiation, microwave, etc., in order to deposit alkali metal or alkaline earth metal mostly to the field which an alkali-metal salt or an alkaline-earth-metal salt wants to deposit] according to claim 9 to 12 is desirable.

[0040] Here, it is applicable, if it is the forming method in the state where moisture was otherwise contained at the time of fabrication, such as extrusion molding, spinning lathe fabrication, and wet pressing, as a forming cycle, although slurry casting is raised to the example. Moreover, since an alkali-metal salt cannot be added, although the manufacture method according to claim 8 which carries out alkali-metal salt addition is inapplicable by dry pressing methods, such as powder press forming, it is possible to apply the manufacture method which applies an alkali-metal salt to the Plastic-solid surface section according to claim 14.

[0041] Base flexural strength is the value measured by the $\phi 14 \times 130$ mm test piece by the method of bending three points on condition that span 100mm and crosshead speed 2.5 mm/min by the Shimazu autograph.

[0042] Baking deformation supports the test piece (base in which it does not calcinate) with width of face 30, a thickness [15], and a length of 260mm, by span 200mm at the time of baking, and is the value which measured the amount of deflections after baking, and the thickness of a test piece. Since the amount of deflections at this time is in inverse proportion to the square of the thickness of the test piece after baking, it makes deformation the amount of deflections converted when thickness was 10mm by

the following formula.

Amount measured-value of baking deformation = deflections (thickness of test piece after baking) $2/102$ [0043] The deformation at the time of reheating supports a test piece (baking base) with width of face of 25mm, a thickness [of 5mm], and a length of 230mm by two span 200mm points, it carries out a temperature up to 1000 degrees C in 4 hours, and it carries out a temperature up to 1200 more degrees C in 2 hours, and after holding at 1200 degrees C for 1 hour, it makes the amount of deflections of the test piece when cooling naturally to a room temperature the deformation at the time of reheating. However, about the case where the thickness of a test piece is not 5mm, the amount of deflections makes the value amended since it was in inverse proportion to the thickness of a test piece the deformation at the time of reheating. The amendment method surveys deformation at the time of reheating by the test piece of two kinds of different thickness, computes n by the following formula, and calculates the deformation at the time of reheating in case the thickness of a test piece is 5mm further.

deformation 2 = deformation 1 $\times (1/\text{thickness 2 of thickness } n \text{ deformation 1: -- deformation deformation 2: at the time of reheating by the test piece of thickness 1 -- deformation } n: \text{ at the time of reheating by the test piece of thickness 2 -- the constant for amendment [0044] It substitutes for the base fracture surface as ink penetrances other than the surface section. After carrying out about the measuring method according to JISA5207, making a test piece with width of face 30, a thickness [15], and a length of 130mm fracture, making the fracture surface immersed for 1 hour or more in a red ink solution (eosine Y solution of 1% of concentration) and wiping off ink, it is the value which measured the maximum osmosis size which permeated in the base.$

[0045] A surface section ink penetrance Width of face 30, thickness 15, the rear face of a test piece with a length of 130mm, So that red ink may not permeate the portion which precise-ization, such as a cross section, has not accomplished Paraffin, After carrying out filling by the resin etc., and the surface section makes it immersed for 1 hour or more in the red ink solution (eosine Y solution of 1% of concentration) of an amount immersed enough and wipes off ink, it is the value which measured the maximum osmosis size which fractured the sample and permeated in the base.

[0046] The physical properties and chemical analysis of an example and the example of comparison are shown in drawing 3 . The example 1 of comparison is general **.ized simple ground composition, and since sintering is advancing completely, the fracture surface and the surface section of an ink penetrance are 0.1mm. However, it turns out that burning shrinkage and deformation show the biggest value. The example 2 of comparison is the composition which substituted for the feldspar with which many sintering-acid components are contained, and the dolomite from the example 1 of comparison to the kaolin. The amount of an alkali-metal oxide is 2 % of the weight or more, burning shrinkage and deformation are still large, and an ink penetrance is in the state where the water absorption from a front face cannot be prevented at all, in 8.0mm. The example 3 of comparison is the case where refractories raw materials, such as a chamotte, are used together, and is the preparation which decreased the amount of alkali-metal oxides of the base itself, and the amount of alkaline-earth-metal oxides as much as possible. In this case, 3.9%, a burning shrinkage is 4.3mm in deformation, and is quite small. However, since the alkali-metal salt is not added, especially, the alkali-metal oxide content of the surface section does not become high, either, and cannot be attaining surface precise-ization.

[0047] An example 1 adds an alkali-metal salt 0.4% in a total amount for the example 2 of comparison. In this base composition, the surface section alkali-metal oxide content indicates the high value to be 5.2%, consequently precise-ization of the surface section can be attained, and the ink penetrance has become 0.1mm. However, the amount of the alkali-metal oxide of the base itself is 2 % of the weight or more, and has become height a little about burning shrinkage and deformation. An example 2 adds an alkali-metal salt 0.3% in a total amount for the example 3 of comparison. The alkali-metal oxide content of the surface section is high according to it. However, since it is about 3.8%, although the absorptivity from a front face is quite small rather than the example 3 of comparison, an ink penetrance is 3.5mm and is higher a little.

[0048] An example 3 adds an alkali-metal salt 0.6% in a total amount for the example 3 of comparison. In spite of being very small with the burning shrinkage of 4.4%, and the deformation of 4.4mm, a

surface ink penetrance is 0.1mm. This is the result of vitrification of the surface section advancing, since the alkali-metal oxide content of the surface section was very high with 7.2%. An example 4 changes the addition ratio of an alkali-metal salt, and changes it to 0.4% in a total amount. Also with this addition, the alkali-metal oxide content of the surface section shows 6.8% and the high value, and has obtained the good result by 0.2mm of ink penetrances. An example 5 makes [more] the inner Na₂O component of an alkali-metal oxide base component in preparation of an example 2 than a K₂O component.

Although the whole burning shrinkage is almost changeless, surface precise metaplasia is improving and the ink penetrance has become 2.0mm. Moreover, although an example 6 makes a Na₂O component increase further, about this, the ink penetrance has brought 0.5mm and a still better result. Thus, it is possible to raise the effect of surface precise metaplasia also by selection of the alkali-metal oxide component as a sintering acid among the components which constitute a base.

[0049] An example 7 slushes an example of comparison 3 composition slurry into a plaster mold, and brush coating of the sodium-citrate solution is carried out to a sample front face 20% after a sludge, and it is dried and calcinated. Moreover, an example 8 creates a sample by the same forming method as an example 7, and it carries out dipping for 1 minute into 20% potassium-citrate solution. Moreover, an example 9 creates a sample by the same forming method as an example 7, and sprays a sodium citrate on a sample front face for 10 minutes 20% by the ultrasonic spraying method. The alkali-metal content of the surface section became 5.7%, 6.8%, and 6.5%, respectively, and all ink penetrances have obtained 0.1mm and the good result. Moreover, other physical-properties values, such as a burning shrinkage, deformation, and flexural strength, show the example 3 of comparison, and the value practically equal. The alkali-metal salt water solution shown in examples 7-9 is not limited to sodium-citrate solution and potassium-citrate solution, and even if they are which alkali-metal salt water solutions, such as a sulfate, acetate, a hydroxide solution, and a complex solution, it gives the same effect. moreover -- although it is the method of application of the alkali-metal salt to a front face -- others -- an atomizer application, a spray application, and a trowel -- the same effect can be given also by methods, such as coating and roller coating

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the cross section of the common seat formula toilet bowl of the example of 1 operation composition concerning this invention.

(a) The cross section of the cross direction of a seat formula toilet bowl

(b) The enlarged view of a rim cross section

[Drawing 2] Base preparation and the chemical composition of the example of this invention, and the example of comparison, a crystal mineral

[Drawing 3] The physical properties and chemical analysis of an example given in drawing 2 , and the example of comparison

[Description of Notations]

- 1 -- Base section
- 2 -- Cover coat layer
- 3 -- Base center section
- 4 -- Base surface section

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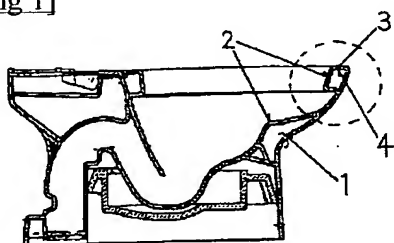
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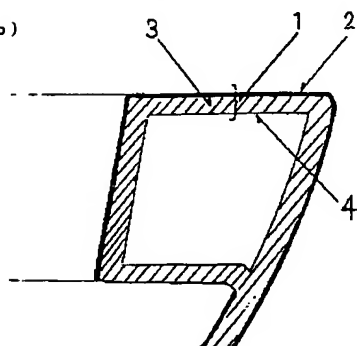
DRAWINGS

[Drawing 1]

(a)



(b)



リム断面 (○ 部) の拡大図

[Drawing 2]

素地 No.		比較例1	比較例2	比較例3	実施例1	実施例2	実施例3	実施例4	実施例5	実施例6	実施例7	実施例8	実施例9
原料調合 (wt%)	セライト陶石	40	30	—	30	—	—	—	—	—	—	—	—
	カリウム陶石	20	30	25	30	25	25	25	25	25	25	25	25
	材料	15	30	20	30	20	20	20	20	20	20	20	20
	珪目粘土	10	10	15	10	15	15	15	15	15	15	15	15
	長石	10	—	—	—	—	—	—	—	—	—	—	—
	ドロマイト	5	—	—	—	—	—	—	—	—	—	—	—
	ガラスハット	—	—	15	—	15	15	15	15	15	15	15	15
	絹石	—	—	15	—	15	15	15	15	15	15	15	15
	焼成バント頁岩	—	—	10	—	10	10	10	10	10	10	10	10
	クエン酸アム	—	—	—	0.1	0.1	0.2	0.1	0.1	0.1	—	—	—
7%カリ 金属塩	クエン酸ナリウム	—	—	—	0.1	0.2	0.4	0.1	0.2	0.2	刷毛 塗り	—	超音 波噴 霧
	クエン酸カリウム	—	—	—	0.2	—	—	0.2	—	—	—	アイワ ビツク	—
	化学組成												
結晶鉱物	SiO ₂	65.2	63.9	59.7	63.9	59.1	58.9	58.7	58.6	59.5	59.7	59.7	59.7
	Al ₂ O ₃	29.5	32.0	34.6	32.0	34.0	33.8	33.3	33.7	34.5	34.6	34.6	34.6
	MgO, CaO	2.2	0.5	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Na ₂ O	1.6	1.0	0.2	1.1	0.3	0.3	0.3	0.6	1.2	0.2	0.2	0.2
	K ₂ O	2.0	1.4	0.7	1.7	0.8	0.9	0.9	0.6	0.2	0.7	0.7	0.7
	ムライト	○	○	○	○	○	○	○	○	○	○	○	○
石英	石英	○	○	○	○	○	○	○	○	○	○	○	○
	コランダム	×	○	○	○	○	○	○	○	○	○	○	○

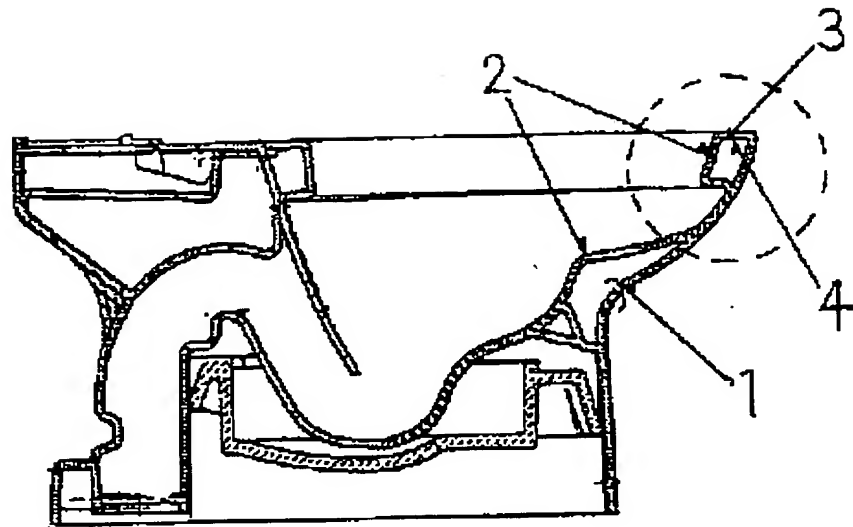
結晶鉱物欄記号説明 : ○ 素地中に結晶鉱物を含有する。 × 素地中に結晶鉱物を含有しない。

[Drawing 3]

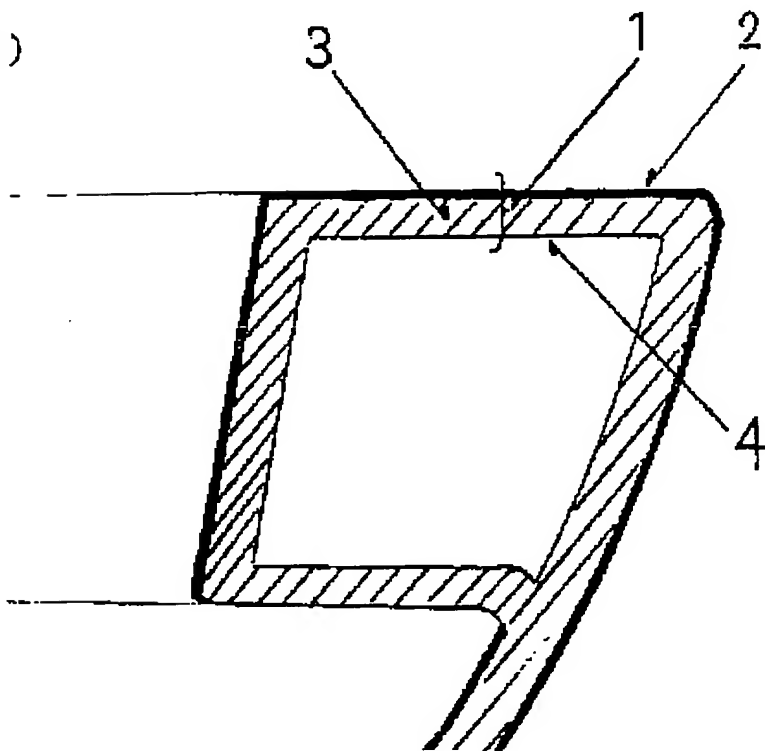
素地 No.	比較例 1	比較例 2	比較例 3	実施例 1	実施例 2	実施例 3	実施例 4	実施例 5	実施例 6	実施例 7	実施例 8	実施例 9
破断面インキ浸透度 (mm)	0.1	8.0 以上										
表面インキ浸透度 (mm)	0.1	8.0 以上	8.0 以上	0.1	3.5	0.1	0.2	2.0	0.5	0.1	0.1	0.1
焼成収縮率(%)	9.8	7.1	3.9	7.4	4.0	4.4	4.3	4.1	4.2	3.8	3.9	3.8
変形量(mm)	30.2	17.5	4.3	16.9	5.4	4.4	4.8	5.0	5.3	4.1	4.2	4.2
再加熱変形量(mm)	18.8	2.5	0	2.9	0.2	0	0	0.1	0	0	0	0
曲げ強度(MPa)	78.6	58.5	55.2	65.4	55.4	55.5	57.5	56.8	56.4	56.9	57.2	56.5
線熱膨張係数 ($\times 10^{-7}/^{\circ}\text{C}$)	70.6	77.8	79.2	79.2	79.8	80.3	79.5	79.0	77.7	76.5	76.6	76.3
表面部7%リ金属 酸化物含有量(wt%)	3.8	2.6	1.6	5.2	3.8	7.2	6.8	3.9	4.1	5.7	6.8	6.5
中央部7%リ金属 酸化物含有量(wt%)	3.6	2.3	1.2	2.7	1.3	1.5	1.4	1.4	1.5	1.3	1.4	1.5

[Translation done.]

(a)



(b)



リム断面 (○部) の拡大図

(19) 日本国特許庁 (J P)

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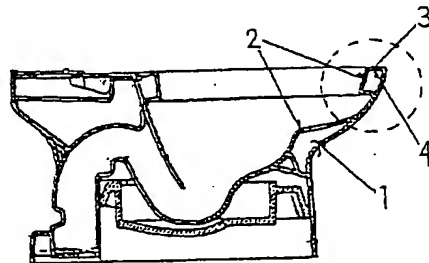
(54) 【発明の名称】 陶磁器及びその製造方法

(57) 【要約】

【課題】 水和膨張による経年貫入、凍害、また汚染等の衛生面に問題が生じず、かつ製造時に修正作業等をせずとも製品寸法の精度の良好な陶磁器を提供可能とすること。

【解決手段】 素地とその上の必要な部分に形成される釉薬層からなる陶磁器であって、前記素地の中央部は吸水性のある陶器質素地からなり、前記素地の表面部のうち、少なくとも釉薬層が形成されていない部分では、吸水性が前記素地の中央部よりも小さくなっていることを特徴とする陶磁器。

(a)



(b)

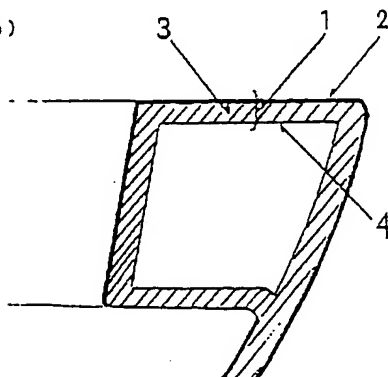


図1は、図2の素地部分を示す。

【特許請求の範囲】

【請求項1】 素地とその上の必要な部分に形成される釉薬層からなる陶磁器であって、前記素地の中央部は吸水性のある陶器質素地からなり、前記素地の表面部のうち、少なくとも釉薬層が形成されていない部分では、吸水性が前記素地の中央部よりも小さくなっていることを特徴とする陶磁器。

【請求項2】 素地とその上の必要な部分に形成される釉薬層からなる陶磁器であって、前記素地の中央部はインキ浸透度が3mmより大きく、かつ前記素地の表面部のうち、少なくとも釉薬層が形成されていない部分では、インキ浸透度が3mm以下であることを特徴とする陶磁器。

【請求項3】 前記素地の中央部は、その主成分の組成が、 SiO_2 45～70重量%、 Al_2O_3 25～50重量%であり、その他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び／又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が2重量%以下であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%以下であり、前記素地の表面部は、その主成分の組成が SiO_2 45～70重量%、 Al_2O_3 25～50重量%でありその他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び／又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が5重量%以上であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%より多いことを特徴とする請求項1又は2に記載の陶磁器。

【請求項4】 前記素地の中央部には、さらに、結晶として石英、クリストバライト、ムライト、コランダムからなる群から選ばれる少なくとも1種の鉱物が含有されていることを特徴とする請求項3に記載の陶磁器。

【請求項5】 前記素地の中央部を構成する成分のうち、アルカリ金属酸化物の含有量において、 Na_2O の重量%が K_2O の重量%より多いことを特徴とする請求項3又は4に記載の陶磁器。

【請求項6】 前記素地の中央部を構成する成分のうち、 Na_2O 含有量が1重量%以上であることを特徴とする請求項3～5に記載の陶磁器。

【請求項7】 前記陶磁器と同一の素地及び釉薬を用い

テストピースを用いてオートグラフによりスパン100mm、クロスヘッドスピード2.5mm/minの条件で3点曲げ試験したときに算出される曲げ強度が30MPa以上であり、かつ前記陶磁器と同一の素地及び釉薬を用いて、幅25mm、厚み5mm、長さ230mmのテストピースを作製し、そのテストピースをスパン200mmの2点で支持し、1000℃まで4時間で昇温し、さらに1200℃まで2時間で昇温し、1200℃で1時間保持した後、室温まで自然冷却したときのテストピースのたわみ量が5mm以下であることを特徴とする請求項3～6に記載の陶磁器。

【請求項8】 前記陶磁器と同一の素地及び釉薬を用いて、テストピースを作製したときの、そのテストピースの長手方向の線熱膨張係数が $90 \times 10^{-7}/^\circ\text{C}$ 以下であることを特徴とする請求項7に記載の陶磁器。

【請求項9】 前記陶磁器は、洗面器、小便器、大便器、ベビーバス、便器のサナ、手洗器、便器タンクのいずれかであることを特徴とする請求項1～8に記載の陶磁器。

【請求項10】 請求項1～9に記載の陶磁器の製造方法であって、 SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行うことにより素地原料を作製する素地調製工程と、前記素地原料に水及びNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶性のある化合物を少なくとも1種添加する工程とを順次行った後、成形素地を形成する成形工程、前記成形素地を乾燥する乾燥工程、前記成形素地上に釉薬を適用する施釉工程、焼成工程を行うことを特徴とする陶磁器の製造方法。

【請求項11】 前記乾燥工程において、アルカリ金属またはアルカリ土類金属を所定表面部により多く移動させるために、前記所定表面部からの水分蒸発速度を速める処理を行うことを特徴とする請求項10に記載の陶磁器の製造方法。

【請求項12】 前記陶磁器は大便器であり、前記所定表面部はトラップ内部又はリム内部であることを特徴とする請求項11に記載の陶磁器の製造方法。

【請求項13】 前記陶磁器は洗面器であり、前記所定表面部はオーバーフロー内部であることを特徴とする請求項11に記載の陶磁器の製造方法。

【請求項14】 前記処理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、温風または冷風を流す処理であることを特徴とする請求項11～13に記載の陶磁器の製造方法

【請求項15】 前記処理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、赤外線ランプのような放射熱源による熱を照射す

の陶磁器の製造方法。

【請求項16】 前記処理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、マイクロ波加熱を加え、乾燥を促進する処理であることを特徴とする請求項11～13に記載の陶磁器の製造方法。

【請求項17】 前記水溶解性のある化合物は、炭酸塩、酢酸塩、硫酸塩、クエン酸塩のいずれかであることを特徴とする請求項10～16に記載の陶磁器の製造方法。

【請求項18】 請求項1～9に記載の陶磁器の製造方法であって、 SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行うことにより素地原料を作製する素地調製工程と、前記素地原料を用いて成形することにより成形素地を形成する工程、必要に応じて乾燥する工程を順次行った後、前記成形素地表面にNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物の少なくとも1種を含む水溶液を表面に塗布する塗布工程、乾燥する工程、前記成形素地上に釉薬を適用する施釉工程、焼成する工程を行うことを特徴とする陶磁器の製造方法。

【請求項19】 前記塗布工程における塗布方法が超音波を用いた噴霧方式であることを特徴とする請求項18に記載の陶磁器の製造方法。

【請求項20】 前記陶磁器は大便器であり、前記所定表面部はトラップ内部又はリム内部であることを特徴とする請求項19に記載の陶磁器の製造方法。

【請求項21】 前記陶磁器は洗面器であり、前記所定表面部はオーバーフロー内部であることを特徴とする請求項19に記載の陶磁器の製造方法。

【請求項22】 前記素地原料は、主要鉱物の必須成分としてカオリナイト、ディッカイト、ハロイサイト、セリサイト、パイロフィライトから選ばれた少なくとも1種からなる粘土質鉱物と石英とを含み、任意成分として必要に応じてムライト、コランダム、ダイアスポアから選ばれた少なくとも1種の鉱物を含んでおり、その他の成分として必要に応じて長石等のアルカリ金属含有鉱物やドロマイト等アルカリ土類金属含有鉱物を含んでいることを特徴とする請求項10～21に記載の陶磁器の製造方法。

【請求項23】 前記素地原料は、レーザー回折式粒度測定器により測定する平均粒子径が $1\sim 20\mu\text{m}$ であることを特徴とする請求項10～22に記載の陶磁器の製造方法。

【請求項24】 前記成形工程における成形方法が泥漿鑄込み成形であることを特徴とする請求項10～23に記載の陶磁器の製造方法。

【請求項25】 前記焼成工程における焼成温度は、 $1100\sim 1300^\circ\text{C}$ であることを特徴とする請求項10

～24に記載の陶磁器の製造方法。

【請求項26】 前記焼成工程における少なくとも長手方向の収縮量が7%以下であることを特徴とする請求項10～25に記載の陶磁器の製造方法。

【請求項27】 前記成形工程にて幅30、厚み15、長さ260mmのテストピース成形体を作製し、このテストピース成形体をスパン200mmで支持して、陶磁器と同一の焼成条件で焼成したときのたわみ量が焼成体厚み10mm相当に換算して20mm以下であることを特徴とする請求項10～26に記載の陶磁器の製造方法。

【請求項28】 請求項10～27に記載の陶磁器の製造方法により作成可能であることを特徴とする陶磁器。

【請求項29】 前記陶磁器は、洗面器、小便器、大便器、ベビーバス、便器のサナ、手洗器、便器タンクのいずれかであることを特徴とする請求項28に記載の陶磁器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、衛生陶器、タイル、食器などに代表される陶磁器及びその製造方法に関する。

【0002】

【従来の技術】陶磁器製品は、一般的に、陶磁器質素地上の必要な部分にのみ釉薬層が形成されており、例えば、便器の床設置部等、タイル裏面、食器の円状の脚部では釉薬層が形成されずに素地が露出している。

【0003】従って、素地を陶器質で形成すると、一般に陶器には吸水があるため、上記素地露出部を介して水が素地に浸透し、水和膨張による経年貫入や寒冷地における凍害等の問題が生じる場合がある。そこで、従来より、焼成熔化させることにより、ガラス相を生成させ、ガラス相が素地中の粒子間の隙間を埋め、素地全体を緻密化させ、吸水性をなくす工夫がなされてきた。

【0004】

【発明が解決しようとする課題】しかしながら、このような焼結過程を経ることが、素地の大きな焼成収縮・変形を生ぜしめ、製品寸法の精度を悪化させる原因となっていた。すなわち、ねらいとする製品寸法を得るためには、焼成収縮量や収縮に伴う変形を考慮した生寸法形状を割り出すという、いわゆる割掛けを行っていたが、焼成収縮が大きいため、焼成雰囲気等によるバラツキも大きく、場合によっては、研削等による修正作業を必要とされていた。本発明は、上記事情に鑑みてなされたものであり、その目的は、水和膨張による経年貫入、凍害、また汚染等の衛生面に問題が生じず、かつ製造時に修正作業等をせずとも製品寸法の精度の良好な陶磁器を提供可能とすることにある。

【0005】

【課題を解決するための手段】本発明では、上記課題を解決すべく、素地とその上の必要な部分に形成される釉

葉層からなる陶磁器であって、前記素地の中央部は吸水性のある陶器質素地からなり、前記素地の表面部のうち、少なくとも釉葉層が形成されていない部分では、吸水性が前記素地の中央部よりも小さくなっていることを特徴とする陶磁器を提供する。そうすることで、素地の中央部は吸水性のある陶器質素地なので、焼成時の収縮・変形を可能な限り抑えて作製可能であり、かつ素地の表面部のうち、少なくとも釉葉層が形成されていない部分では、吸水性が前記素地の中央部よりも小さくなっているため、素地露出部における吸水が抑制され、水和膨張による経年貫入や寒冷地における凍害等の問題が生じにくい。

【0006】本発明の好ましい態様においては、素地とその上の必要な部分に形成される釉葉層からなる陶磁器であって、前記素地の中央部はインキ浸透度が3mmより大きく、かつ前記素地の表面部のうち、少なくとも釉葉層が形成されていない部分では、インキ浸透度が3mm以下であるようにする。そうすることで、素地の中央部はインキ浸透度が3mm以上と多孔質で吸水性のある陶器質素地なので、焼成時の収縮・変形を可能な限り抑えて作製可能であり、かつ素地の表面部のうち、少なくとも釉葉層が形成されていない部分では、インキ浸透度が3mm以下であるため、素地露出部からの吸水が抑制され、水和膨張による経年貫入や寒冷地における凍害等の問題が生じにくい。

【0007】本発明の好ましい態様においては、前記素地の中央部は、その主成分の組成が、 SiO_2 45～70重量%、 Al_2O_3 2.5～5.0重量%であり、その他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び/又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が2重量%以下であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%以下であり、前記素地の表面部は、その主成分の組成が SiO_2 4.5～7.0重量%、 Al_2O_3 2.5～5.0重量%でありその他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び/又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が5重量%以上であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%より多いようにする。中央部の組

成は、少なくとも1種のアルカリ金属酸化物の総量が2重量%以下であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%以下であるようにすることで、ガラス相の生成が抑制され、焼成収縮やそれに伴う変形が小さくなる。かつ表面部の組成について、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が5重量%以上であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%より多いようにすることで、表面部においてはガラス相の生成が促進されて緻密化し、吸水が抑制される。従って、水和膨張による経年貫入や寒冷地における凍害等の問題が生じにくくなる。

【0008】本発明の好ましい態様においては、素地の中央部には、さらに、結晶として石英、クリストバライト、ムライト、コランダムからなる群から選ばれる少なくとも1種の鉱物が含有されているようにする。そうすることで、素地中央部の強度が向上する。

【0009】本発明の好ましい態様においては、前記素地の中央部を構成する成分のうち、アルカリ金属酸化物の含有量において、 Na_2O の重量%が K_2O の重量%より多いようにする。そうすることで、表面のガラス化を進行させる場合において、NaがKよりも焼結助剤としての効果が高いので、その結果、表面部の緻密化の効果が高まる。

【0010】本発明の好ましい態様においては、素地の中央部を構成する成分のうち、 Na_2O 含有量が1重量%以上であるようにする。そうすることで、表面のガラス化がより進行し、表面部の緻密化の効果が高まる。

【0011】本発明の好ましい態様においては、前記陶磁器と同一の素地及び釉葉を用いて、 $\phi 14 \times 130$ mmのテストピースを作製し、そのテストピースを用いてオートグラフによりスパン100mm、クロスヘッドスピード2.5mm/minの条件で3点曲げ試験したときに算出される曲げ強度が30MPa以上であり、かつ前記陶磁器と同一の素地及び釉葉を用いて、幅25mm、厚み5mm、長さ230mmのテストピースを作製し、そのテストピースをスパン200mmの2点で支持し、1000℃まで4時間で昇温し、さらに1200℃まで2時間で昇温し、1200℃で1時間保持した後、室温まで自然冷却したときのテストピースのたわみ量が5mm以下であるようにする。そうすることで、通常製品として使用可能な強度を有し、焼成変形が小さく、寸法精度の安定した製品を得ることができる。

【0012】本発明の好ましい態様においては、さらに、前記陶磁器と同一の素地及び釉葉を用いて、テスト

の線熱膨張係数が $90 \times 10^{-7}/^{\circ}\text{C}$ 以下であるようにする。そうすることで、一般的に陶磁器製品に使用されている釉薬とのマッチングが良く、釉飛び、貫入等の釉薬面の欠点発生が生じにくくなる。また、素地自体の焼成工程時の冷却過程における素地切れを抑制し、さらに耐熱衝撃性が向上する。

【0013】本発明の陶磁器の一製造方法においては、 SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行うことにより素地原料を作製する素地調製工程と、前記素地原料に水及びNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物を少なくとも1種添加する工程とを順次行った後、成形素地を形成する成形工程、前記成形素地を乾燥する乾燥工程、前記成形素地上に釉薬を適用する施釉工程、焼成工程を行うようにする。Na、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属やホウ素のいずれかを含む水溶解性のある化合物の中から、少なくとも1種の化合物を添加し、成形後乾燥させることにより、乾燥工程において、アルカリ金属酸化物成分またはアルカリ土類金属酸化物成分が水分と同時に表面に移行し、表面部のアルカリ金属酸化物成分またはアルカリ土類金属酸化物成分が素地中央部より多くなり、焼成時に表面部のみガラス化が進行しやすくなる。結果として、表面部の緻密化が図れ、表面部の吸水性を抑制するとともに、素地中央部の焼成収縮を小さくすることが可能となる。

【0014】本発明の好ましい態様においては、前記乾燥工程において、アルカリ金属またはアルカリ土類金属を所定表面部により多く移動させるために、前記所定表面部からの水分蒸発速度を速める処理を行うようにすることにより、所定表面部により多くのアルカリ金属やアルカリ土類金属が移動し、所定表面部の緻密化が促進され、表面部の吸水性が抑制される。

【0015】本発明の好ましい態様においては、前記陶磁器は大便器であり、前記所定表面部はトラップ内部又はリム内部であるようにする。そうすることで、乾燥し難いトラップ内部又はリム内部でも、水分蒸発速度が速められて、充分量のアルカリ金属またはアルカリ土類金属が表面部に移動可能となる。従って、表面部の緻密化が促進され、表面部のガラス化が進行し吸水性が抑制される。

【0016】本発明の好ましい態様においては、前記陶磁器は洗面器であり、前記陶磁器はオーバーフロー内部であるようにする。そうすることで、乾燥し難いオーバーフロー内部でも、水分蒸発速度が速められて、充分量のアルカリ金属またはアルカリ土類金属が表面部に移動可能となる。従って、表面部の緻密化が促進され、表面部のガラス化が進行し吸水性が抑制される。

【0017】本発明の好ましい態様においては、前記処

理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、温風または冷風を流す処理であるようにする。そうすることで、上記のような乾燥し難い部位にも容易に処理が可能である。

【0018】本発明の好ましい態様においては、前記処理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、赤外線ランプのような放射熱源による熱を照射する処理であるようにする。そうすることで、上記のような乾燥し難い部位にも容易に処理が可能である。

【0019】本発明の好ましい態様においては、前記処理は、アルカリ金属またはアルカリ土類金属を移動させたい面に対して、アルカリ金属またはアルカリ土類金属を表面により多く移動させるために、マイクロ波加熱を加え、乾燥を促進する処理であるようにする。そうすることで、上記のような乾燥し難い部位にも容易に処理が可能である。

【0020】本発明の好ましい態様においては、前記水溶解性のある化合物は、炭酸塩、酢酸塩、硫酸塩、クエン酸塩のいずれかであるようにする。原料スラリーに水溶解性のアルカリ金属塩を添加すると原料スラリーが凝集してしまい、鑄込み成形などが困難となってしまう場合があるが、添加するアルカリ金属塩として炭酸塩、硫酸塩、酢酸塩、クエン酸塩を用いると、原料スラリーが凝集しにくくなるので好ましい。

【0021】本発明の陶磁器の他の製造方法においては、 SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行うことにより素地原料を作製する素地調製工程と、前記素地原料を用いて成形することにより成形素地を形成する工程、必要に応じて乾燥する工程を順次行った後、前記成形素地表面にNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物の少なくとも1種を含む水溶液を表面に塗布する塗布工程、乾燥する工程、前記成形素地上に釉薬を適用する施釉工程、焼成する工程を行うようにする。このように成形の後工程において成形素地表面にNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物の少なくとも1種を含む水溶液を表面に塗布することによって、表面部のアルカリ金属酸化物成分またはアルカリ土類金属酸化物成分が素地中央部より多くなり、焼成時に表面部のみガラス化が進行しやすくなる。結果として、表面部の緻密化が図れ、表面部の吸水性を抑制するとともに、素地中央部の焼成収縮を小さくすることが可能となる。

【0022】本発明の好ましい態様においては、前記塗布工程における塗布方法が超音波を用いた噴霧方式であるようにする。そうすることにより、大便器のトラップ

内部又はリム内部や、洗面器のオーバーフロー内部のような塗布し難い部分にも容易に塗布することができる。

【0023】本発明の好ましい態様においては、前記素地原料は、主要鉱物の必須成分としてカオリナイト、ディッカイト、ハロイサイト、セリサイト、パイロフィライトから選ばれた少なくとも1種からなる粘土質鉱物と石英とを含み、任意成分として必要に応じてムライト、コランダム、ダイアスポアから選ばれた少なくとも1種の鉱物を含んでおり、その他の成分として必要に応じて長石等のアルカリ金属含有鉱物やドロマイト等アルカリ土類金属含有鉱物を含んでいるようにする。そうすることにより、粘土質鉱物による成形性を保持しつつ、焼成工程における石英の熔化により素地マトリックスを強固なものにし、さらに任意成分としての、ムライト、コランダム、ダイアスポア鉱物、または、アルカリ土類含有鉱物、アルカリ土類金属含有鉱物によって、素地中央部の強度を向上させることができる。

【0024】本発明の好ましい態様においては、前記素地原料は、レーザー回折式粒度測定器により測定する平均粒子径が $1\sim 20\mu\text{m}$ 、好ましくは $5\sim 10\mu\text{m}$ であるようにする。平均粒子径が $1\mu\text{m}$ 以下になると、泥漿の凝集状態が激しくなって解膠が困難になり、成形性に問題を生じる。また、平均粒子径が $20\mu\text{m}$ 以上になると素地の熔化焼結が不十分となり十分な強度を得ることができない。

【0025】本発明の好ましい態様においては、前記成形工程における成形方法が泥漿鑄込み成形であるようにする。そうであることにより、表面部の緻密化に必要不可欠なアルカリ金属塩またはアルカリ土類金属塩を泥漿中に容易に配合させることができ、また、衛生陶器に代表される大型複雑形状品を寸法精度良く、容易に成形することができる。

【0026】本発明の好ましい態様においては、前記焼成工程における焼成温度は、 $1100\sim 1300^\circ\text{C}$ であるようにする。 $1100^\circ\text{C}\sim 1300^\circ\text{C}$ という高火度焼成により、素地強度を極端に低下させることなく、曲げ強度で 30MPa 以上という、実用上問題のない強度を有することが可能となっている。焼成温度が 1100°C より低いと素地の熔化、鉱物化が不十分となり、ねらいとする強度を得ることができない。また、 1300°C より高いと熔化焼結が進行しすぎるため、ねらいとする焼成収縮量、変形量を得ることができなくなる。

【0027】本発明の好ましい態様においては、前記焼成工程における少なくとも長手方向の収縮量が7%以下であるようにする。そうすることにより、焼成工程時の焼成収縮量のバラツキが小さくなり、寸法精度の安定した製品を得ることができる。

【0028】本発明の好ましい態様においては、前記成形工程にて幅30、厚み15、長さ260mmのテストピース成形体を作製し、このテストピース成形体をバ

ン 200mm で支持して、陶磁器と同一の焼成条件で焼成したときのたわみ量が焼成体厚み 10mm 相当に換算して 20mm 以下であるようにする。そうすることにより、焼成工程時の焼成変形量が小さくなり、寸法精度の安定した製品を得ることができる。

【0029】

【発明の実施の形態】以下に本発明の一実施構成例について、図1に基づいて、説明する。本発明では、素地1上の必要な部分に釉薬層2が形成されている。素地1はその中央部3と表面部4で構成が異なっている。そして、中央部3は吸水性のある陶器質素地からなり、表面部4では、中央部3よりも吸水性が小さくなっている。中央部3の組成は、その主成分の組成が、 SiO_2 45～70重量%、 Al_2O_3 25～50重量%であり、その他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び/又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、結晶として石英、クリストバライト、ムライト、コランダムからなる群から選ばれる少なくとも1種の鉱物が含有され、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が2重量%以下であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%以下である。また、 Na_2O の重量%が K_2O の重量%より多く、素地を構成する全酸化物に対して1重量%以上含有されている。また、表面部4の組成は、その主成分の組成が SiO_2 45～70重量%、 Al_2O_3 25～50重量%であり、その他の組成成分として、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物及び/又は CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物を含み、 Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物の総量が5重量%以上であり、かつ Na_2O 、 K_2O 、 Li_2O からなる群から選ばれた少なくとも1種のアルカリ金属酸化物と CaO 、 MgO 、 BaO 、 BeO からなる群から選ばれた少なくとも1種のアルカリ土類金属酸化物の総量が6重量%より多くなっている。

【0030】図1の陶磁器は、同一の構成及び組成の素地及び釉薬を用いて、 $\phi 14\times 130\text{mm}$ のテストピースを作製し、そのテストピースを用いてオートグラフによりスパン 100mm 、クロスヘッドスピード 2.5mm/min の条件で3点曲げ試験したときに算出される曲げ強度が 30MPa 以上である。また、陶磁器と同一の構成及び組成の素地及び釉薬を用いて、幅 25mm 、厚み 5mm 、長さ 230mm のテストピースを作製し、そのテストピースをスパン 200mm の2点で支持し、 1000N の力で試験する。

間で昇温し、1200℃で1時間保持した後、室温まで自然冷却したときのテストピースのたわみ量が5mm以下である。さらに、陶磁器と同一の構成及び組成の素地及び釉薬を用いて、テストピースを作製したときの、そのテストピースの長手方向の線熱膨張係数が $90 \times 10^{-7}/^{\circ}\text{C}$ 以下である。

【0031】上記陶磁器は、水和膨張による経年貫入、凍害、また汚染等の衛生面に問題が生じず、かつ製造時に修正作業等をせずとも製品寸法の精度が良好である。従って、洗面器、小便器、大便器、ベビーバス、便器のサナ、手洗器、便器タンク等に広範囲に利用可能である。

【0032】図1の陶磁器は、例えば、以下に示す2つの方法により作製可能である。

(1) SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行い、レーザー回折式粒度測定器により測定する平均粒子径が $1 \sim 20 \mu\text{m}$ である素地原料を作製する素地調製工程と、前記素地原料に水及びNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物を少なくとも1種添加する工程とを順次行った後、泥漿鑄込み成形等の方法により成形素地を形成する成形工程、前記成形素地を乾燥する乾燥工程、前記成形素地上に釉薬を適用する施釉工程、 $1100 \sim 1300^{\circ}\text{C}$ の温度で焼成工程を行う。

(2) SiO_2 、 Al_2O_3 を主成分とする窯業原料の粒度調整を行い、レーザー回折式粒度測定器により測定する平均粒子径が $1 \sim 20 \mu\text{m}$ である素地原料を作製する素地調製工程と、前記素地原料を用いて泥漿鑄込み成形等の方法により成形することにより成形素地を形成する工程、必要に応じて乾燥する工程を順次行った後、前記成形素地表面にNa、K、Liなどのアルカリ金属、Ca、Mg、Baなどのアルカリ土類金属、ホウ素のいずれかを含む水溶解性のある化合物の少なくとも1種を含む水溶液を表面に塗布する塗布工程、乾燥する工程、前記成形素地上に釉薬を適用する施釉工程、 $1100 \sim 1300^{\circ}\text{C}$ の温度で焼成する工程を行う。

【0033】(1)の方法において、水溶解性のある化合物は、炭酸塩、酢酸塩、硫酸塩、クエン酸塩のいずれかであるとスラリーが凝集しにくく望ましいが、他に、硫酸塩、硝酸塩、水酸化物、金属錯体など水溶解性のアルカリ金属塩であれば使用可能である。また、乾燥工程においては、アルカリ金属またはアルカリ土類金属を表面部4により多く移動させるために、表面部4からの水分蒸発速度を速める処理を行うのが好ましい。その具体的方法としては、温風または冷風を流す方法、赤外線ランプのような放射熱源による熱を照射する方法、マイクロ波加熱を加え、乾燥を促進する方法等が好適に利用可能である。

【0034】(2)の方法において、塗布方法は、一般

的に用いられているディッピング、刷毛塗り、ローラー塗り、コテ塗り、霧吹き、スプレー等を用いることが可能であるが、塗布しにくい箇所に対しては超音波噴霧方式が好ましい。

【0035】(1)、(2)の方法で陶磁器を作製すると、焼成工程では、少なくとも長手方向の収縮量が7%以下であるようになり、かつ乾燥前の工程までを陶磁器と同じ条件にて作製した幅30、厚み15、長さ260mmのテストピース成形体をスパン200mmで支持して、陶磁器と同一の焼成条件で焼成したときのたわみ量が焼成体厚み10mm相当に換算して20mm以下であるようになる。

【0036】次に、本明細書に出てくる語の幾つかにつき、さらに詳細に説明する。表面部とは、素地を成形乾燥、焼成した後、一般的に使用されている表面化学組成分析機器(例えば蛍光X線分析装置 理学電機製3270など)で表面から分析可能な範囲を示し、通常表面から厚み方向へ数 $10 \mu\text{m}$ の範囲である。また、素地中央部とは、焼結体を厚み方向に切断し、表面と裏面のほぼ中央付近に当たる部位を示す。

【0037】窯業原料は、通常の熔化質素地原料として使用されている原料、および、耐火物原料として使用されている原料の双方をさす。ここで、熔化質素地原料とは、例えば、陶石、長石、珪石、雲母、カオリン、珪目粘土、木節粘土、ドロマイトなどであり、耐火物原料とは、例えば、蛭石、パン土頁岩、シャモット、蛭石粘土、耐火粘土、フリントクレイ、ボーキサイト、マグネシアクリンカーなどである。熔化質素地原料と耐火物原料は併用することが望ましい。熔化質素地原料のみの組成で素地を調製した場合よりも、アルカリ金属酸化物およびアルカリ土類金属酸化物含有率が低い蛭石、シャモット原料などの耐火物原料を併用させたほうが、素地中のアルカリ金属酸化物およびアルカリ土類金属酸化物を減少させることが容易だからである。

【0038】超音波式噴霧器とは、一般的に市販されている超音波式加湿器、超音波式吸入器等であり、アルカリ金属またはアルカリ土類金属を含んだ状態で水溶液をミスト化できることが重要である。ミストだからこそ、トラップ等のチューブ形状を成しているものやリム内等の複雑形状の内部に浸透することができるのである。

【0039】

【実施例】図2に本発明の実施例と比較例の素地調製と化学組成、結晶鉱物を示す。素地調製方法は、所定の原材料を秤量し、水35部と解膠剤として珪酸ソーダを適量添加したものをポットミル中で湿式粉碎し、平均粒径を $6 \mu\text{m}$ に調製した。ここで、表面緻密化に寄与するアルカリ金属塩としては、原料スラリーの凝集性が最も低いという理由から、アルカリ金属クエン酸塩を選択し、クエン酸リチウム、クエン酸ナトリウム、クエン酸カリウムを使用した。また、アルカリ金属塩の添加方法であ

るが、素地原材料と同時に一括で添加する方法、素地原材料のみ粒度調整した後、アルカリ金属塩を後添加する方法のいずれでも適用できる。なお、添加するアルカリ金属塩については、前記に限定したものではなく、他に、炭酸塩、硫酸塩、酢酸塩、硝酸塩、水酸化物、金属錯体など水溶解性のアルカリ金属塩であれば使用可能である。次に、原料スラリーを物性測定用サンプルの所定形状に成形可能な石膏型に流し込み、着肉成形後に脱型し、テストピースを成形した。テストピースは、40℃で24hr乾燥した後、電気炉で1000℃まで4時間、1200℃まで2時間で昇温し、1200℃で1時間保持後、自然冷却するヒートカーブにより焼成した。ここで、実施例においては、サンプルベースであるため、すべて40℃の定常乾燥で効果の発現が十分である。ただし、乾燥し難い部位に関しては、請求項9～12に記載の如く、アルカリ金属塩またはアルカリ土類金属塩を析出させたい面に対して、アルカリ金属またはアルカリ土類金属を多く析出させるために、冷風、熱風、赤外線、マイクロ波等を利用することにより表面からの水分蒸発速度を促進することが好ましい。

【0040】ここで、成形工程としては、実施例に泥漿鑄込み成形を上げているが、他に押し出し成形、ろくろ成形、湿式プレス成形など成形時に水分を含有した状態の成形方法であれば適用可能である。また、粉末プレス成形などの乾式成形法では、アルカリ金属塩を添加することができないため、請求項8記載のアルカリ金属塩添加する製造方法は適用できないが、請求項14記載の成形体表面部にアルカリ金属塩を塗布する製造方法を適用することが可能である。

【0041】素地曲げ強度は、 $\phi 14 \times 130$ mmのテストピースにより、島津製オートグラフによりスパン100 mm、クロスヘッドスピード2.5 mm/minの条件で3点曲げ方法で測定した値である。

【0042】焼成変形量は、幅30、厚み15、長さ260 mmのテストピース（未焼成素地）を焼成時にスパン200 mmで支持しておき、焼成後のたわみ量とテストピースの厚みを測定した値である。このときのたわみ量は焼成後のテストピースの厚みの二乗に反比例するため、次式で厚みが10 mmの時に換算したたわみ量を変形量としている。

焼成変形量＝たわみ量測定値 \times （焼成後のテストピースの厚み） $^2/10^2$

【0043】再加熱時の変形量は、幅25 mm、厚み5 mm、長さ230 mmのテストピース（焼成素地）をスパン200 mmの2点で支持し、1000℃まで4時間で昇温し、さらに1200℃まで2時間で昇温し、1200℃で1時間保持した後、室温まで自然冷却したときのテストピースのたわみ量を再加熱時の変形量とする。ただし、テストピースの厚みが5 mmになっていない場合については、たわみ量はテストピースの厚みに反比例す

るので補正した値を再加熱時の変形量とする。その補正方法は、2種類の異なる厚みのテストピースで再加熱時の変形量を実測し、次式で n を算出し、さらにテストピースの厚みが5 mmのときの再加熱時の変形量を求める。

変形量2＝変形量1 \times （厚み1／厚み2） n

変形量1：厚み1のテストピースでの再加熱時の変形量

変形量2：厚み2のテストピースでの再加熱時の変形量

n ：補正のための定数

【0044】表面部以外のインキ浸透度としては、素地破断面を代用している。その測定方法については、JISA 5207に準じて実施しており、幅30、厚み15、長さ130 mmのテストピースを破断させ、破断面を赤インキ溶液（濃度1%のエオシンY溶液）内に1時間以上浸漬させ、インキを拭き取った後、素地内に浸透した最大浸透寸法を測定した値である。

【0045】表面部インキ浸透度は、幅30、厚み15、長さ130 mmのテストピースの裏面、断面など緻密化が成されてない部分に赤インキが浸透しないようにパラフィン、樹脂などで目止めをしたのち、表面部が十分浸漬する量の赤インキ溶液（濃度1%のエオシンY溶液）内に1時間以上浸漬させ、インキを拭き取った後、サンプルを破断し、素地内に浸透した最大浸透寸法を測定した値である。

【0046】図3に実施例と比較例の物性および化学分析値を示す。比較例1は一般的な熔化質素地組成であり、焼結が完全に進行していることから、インキ浸透度は、破断面、表面部とも0.1 mmである。ただし、焼成収縮および変形量は最も大きな値を示していることがわかる。比較例2は比較例1から焼結助剤成分が多く含まれる長石、ドロマイトをカオリンへ代替した組成である。アルカリ金属酸化物の量が2重量%以上であり、焼成収縮、変形量が依然として大きく、かつ、インキ浸透度が8.0 mmで表面からの吸水は全く防止できていない状態である。比較例3は、シャモットなどの耐火物原料を併用した場合であり、素地自体のアルカリ金属酸化物量、アルカリ土類金属酸化物量を極力減少させた調査である。この場合、焼成収縮率は3.9%、変形量4.3 mmであり、かなり小さくなっている。ただし、アルカリ金属塩を添加していないため、表面部のアルカリ金属酸化物含有量も特に高くなっておらず、表面の緻密化は図れていない。

【0047】実施例1は比較例2にアルカリ金属塩を総量で0.4%添加したものである。この素地組成では、表面部アルカリ金属酸化物含有量が5.2%と高い値を示しており、その結果、表面部の緻密化が図れ、インキ浸透度は0.1 mmとなっている。ただし、素地自体のアルカリ金属酸化物の量が2重量%以上であり、焼成収縮、変形量については、若干高めになっている。実施例2は、比較例3にアルカリ金属塩を総量で0.3%添加

したものである。表面部のアルカリ金属酸化物含有量はそれに応じて高くなっている。ただし、3.8%程度であるため、比較例3よりも表面からの吸水性はかなり小さくなっているが、インキ浸透度は3.5mmであり、若干高めである。

【0048】実施例3は、比較例3にアルカリ金属塩を総量で0.6%添加したものである。焼成収縮率4.4%、変形量4.4mmと非常に小さくなっているにもかかわらず、表面のインキ浸透度は0.1mmである。これは、表面部のアルカリ金属酸化物含有量が7.2%と非常に高くなっていることから、表面部のガラス化が進行した結果である。実施例4は、アルカリ金属塩の添加比率を変え総量で0.4%に変更したものである。この添加量でも表面部のアルカリ金属酸化物含有量が6.8%と高い値を示しており、インキ浸透度0.2mmで良好な結果を得ることができている。実施例5は実施例2の調合において、アルカリ金属酸化物素地成分の内 Na_2O 成分を K_2O 成分より多くしたものである。全体の焼成収縮率はほとんど変化がないが、表面の緻密化性が向上しており、インキ浸透度が2.0mmになっている。また、実施例6はさらに Na_2O 成分を増加させたものであるが、これについては、インキ浸透度が0.5mmとさらに良好な結果となっている。このように、素地を構成する成分のうち焼結助剤としてのアルカリ金属酸化物成分の選択によっても、表面緻密化性の効果を向上させることが可能である。

【0049】実施例7は、比較例3組成泥漿を石膏型に流し込み、排泥後、20%クエン酸ナトリウム水溶液をサンプル表面に刷毛塗りし、乾燥・焼成したものである。また、実施例8は、実施例7と同様な成形方法でサンプルを作成し、20%クエン酸カリウム水溶液中に1分間ディッピングしたものである。また、実施例9は実施例7と同様な成形方法でサンプルを作成し、超音波噴

霧方式で20%クエン酸ナトリウムをサンプル表面に10分間噴霧したものである。表面部のアルカリ金属含有量がそれぞれ5.7%、6.8%、6.5%となり、インキ浸透度はすべて0.1mmと良好な結果を得ている。また、焼成収縮率、変形量、曲げ強度など他の物性値は比較例3と大差ない値を示している。実施例7～9に示しているアルカリ金属塩水溶液は、クエン酸ナトリウム水溶液、クエン酸カリウム水溶液に限定されるものではなく、硫酸塩、酢酸塩、水酸化物溶液、錯体溶液などのアルカリ金属塩水溶液であっても同様な効果を与える。また、表面へのアルカリ金属塩の塗布方法であるが、他に霧吹き塗布、スプレー塗布、コテ塗り、ローラー塗りなどの方法によっても同様な効果を与えることができる。

【0050】

【発明の効果】本発明によれば、水和膨張による経年貫入、凍害、また汚染等の衛生面に問題が生じず、かつ製造時に修正作業等をせずとも製品寸法の精度の良好な陶磁器を提供可能とすることができる。

【図面の簡単な説明】

【図1】本発明に係る一実施構成例の一般的な腰掛け式便器の断面図である。

(a) 腰掛け式便器の前後方向の断面図

(b) リム断面の拡大図

【図2】本発明の実施例と比較例の素地調合と化学組成、結晶鉱物

【図3】図2記載の実施例と比較例の物性および化学分析値

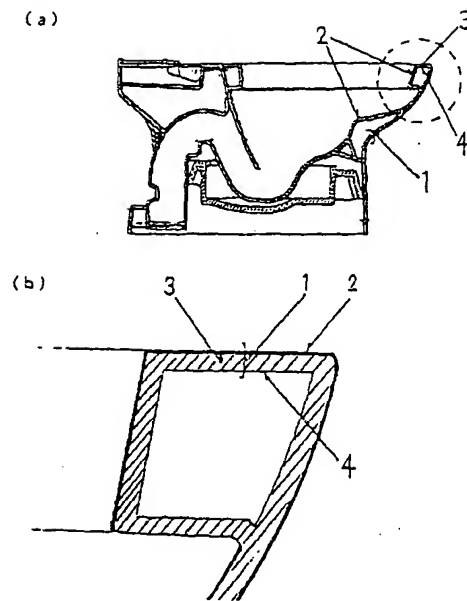
【符号の説明】

- 1…素地部
- 2…釉薬層
- 3…素地中央部
- 4…素地表面部

(10)

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【図1】



リム断面 (3) の拡大図

[図2]

実施例 No.	比較例 1	比較例 2	比較例 3	実施例 1	実施例 2	実施例 3	実施例 4	実施例 5	実施例 6	実施例 7	実施例 8	実施例 9
原料調合 (wt%)	40	30	—	30	—	—	—	—	—	—	—	—
	20	30	25	30	25	25	25	25	25	25	25	25
	15	30	20	30	20	20	20	20	20	20	20	20
	10	10	15	10	15	15	15	15	15	15	15	15
珪目粘土 長石 ドロマイト 珪石 珪石 焼成バント土質岩 クエン酸ナトリウム クエン酸ナトリウム クエン酸ナトリウム	10	—	—	—	—	—	—	—	—	—	—	—
	10	—	—	—	—	—	—	—	—	—	—	—
	5	—	—	—	—	—	—	—	—	—	—	—
	—	—	15	—	15	15	15	15	15	15	15	15
	—	—	15	—	15	15	15	15	15	15	15	15
	—	—	10	—	10	10	10	10	10	10	10	10
	—	—	—	—	—	—	—	—	—	—	—	—
74% 金属塩	—	—	—	0.1	0.1	0.2	0.1	0.1	0.1	0.2	—	超音波噴霧
	—	—	—	0.1	0.2	0.4	0.1	0.2	0.2	刷毛塗り	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	0.2	—	—	0.2	—	—	—	—	—
化学組成	65.2	63.9	59.7	63.9	59.1	58.9	58.7	58.6	59.5	59.7	59.7	59.7
	29.5	32.0	34.6	32.0	34.0	33.8	33.3	33.7	34.5	34.6	34.6	34.6
	2.2	0.5	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	1.6	1.0	0.2	1.1	0.3	0.3	0.3	0.6	1.2	0.2	0.2	0.2
	2.0	1.4	0.7	1.7	0.8	0.9	0.9	0.6	0.2	0.7	0.7	0.7
	—	—	—	—	—	—	—	—	—	—	—	—
結晶鉱物	ムライト	○	○	○	○	○	○	○	○	○	○	○
	石英	○	○	○	○	○	○	○	○	○	○	○
	コランダム	×	○	○	○	○	○	○	○	○	○	○

結晶鉱物欄記号説明 : ○ 素地中に結晶鉱物を含有する。 × 素地中に結晶鉱物を含有しない。

【図3】

素地 No.	比較例1	比較例2	比較例3	実施例1	実施例2	実施例3	実施例4	実施例5	実施例6	実施例7	実施例8	実施例9
破断面インキ浸透度 (mm)	0.1						8.0以上					
表面部インキ浸透度 (mm)	0.1	8.0 以上	8.0 以上	0.1	3.5	0.1	0.2	2.0	0.5	0.1	0.1	0.1
焼成収縮率(%)	9.8	7.1	3.9	7.4	4.0	4.4	4.3	4.1	4.2	3.8	3.9	3.8
変形量(mm)	30.2	17.5	4.3	16.9	5.4	4.4	4.8	5.0	5.3	4.1	4.2	4.2
再加熱変形量(mm)	18.8	2.5	0	2.9	0.2	0	0	0.1	0	0	0	0
曲げ強度(MPa)	78.6	58.5	55.2	65.4	55.4	55.5	57.5	56.8	56.4	56.9	57.2	56.5
線熱膨張係数 ($\times 10^{-7}/^{\circ}\text{C}$)	70.6	77.8	79.2	79.2	79.8	80.3	79.5	79.0	77.7	76.5	76.6	76.3
表面部744l金属 酸化物含有量(wt%)	3.8	2.6	1.6	5.2	3.8	7.2	6.8	3.9	4.1	5.7	6.8	6.5
中央部744l金属 酸化物含有量(wt%)	3.6	2.3	1.2	2.7	1.3	1.5	1.4	1.4	1.5	1.3	1.4	1.5